

XII.—MATERIALS FOR A HISTORY OF THE SWORD-FISH.

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ANALYTICAL SYNOPSIS.

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A.—INTRODUCTORY NOTES.

1. OBJECTS OF THE ESSAY AND SOURCES OF INFORMATION.

This essay upon the Sword-fish and its uses makes no claim to be considered a contribution to knowledge. In the course of six summers' study of fish and fisheries on the coast of New England and as many winters of research into ichthyological literature, a considerable quantity of notes concerning the Sword-fish have accumulated in the writer's portfolio. These are printed below, arranged in systematic order, with the hope that they may stimulate inquiry by showing at a glance what is now known about the habits of this mysterious fish and what it is

desirable should be learned. Such of the facts as have not previously been printed are for the most part drawn from the experience of fishermen either by the writer or by others who have kindly responded to letters asking for information by interviewing their local authorities. Mr. John H. Thomson, of New Bedford; Mr. Willard Nye, of New Bedford; Mr. E. G. Blackford and Mr. Barnet Phillips, of New York; and Mr. O. B. Fuller, of Portland, have aided thus. Capt. Benjamin Ashby, of Nook; Capt. R. H. Hurlbert, John Rowe, and George H. Martin, of Gloucester; and Capt. I. H. Michaux, of New Bedford, veteran swordfishermen, have been asked questions innumerable, and their words are frequently quoted. As far as possible, all statements have been confirmed by personal observation; but for this there has been little opportunity. Few fishes are so difficult to observe, and a student may pass summer after summer in the attempt to study them with few results other than the sight of a few dozen dorsal fins cutting through the water, a chance to measure and dissect a few specimens, a page or two of estimates of annual captures, and perhaps the experience of having the side of his boat pierced by one of the ugly swords.

This paper is the fourth of a series upon The Natural and Economical History of American Food-fishes, the first, on THE SCUPPAUG, and the second, on THE BLUEFISH, having been published by Professor Baird in the Report of the United States Fish Commission, Part I (1873); the third, on THE MENHADEN, in Part V (1879) of the same report. The HISTORY OF THE AMERICAN WHALE FISHERY, by Mr. Alexander Starbuck in Part IV of the same report, is also properly to be enumerated in this series.

B.—NAMES OF THE SWORD-FISH.

2.—POPULAR NAMES OF SWORD-FISH.

The names by which the fish under consideration is known all have reference to its most prominent feature, the prolonged snout. The "Sword-fish" of our own tongue, the "*Zwaard-fis*" of the Hollander, the Italian "*Siffo*" and "*Pesce-epada*", the Spaniard's "*Espada*", "*Espadarte*", and varied by "*Pez de epada*" in Cuba, and the French "*Espadon*", "*Dard*", and "*Épée de mer*" are simply variations of one theme, repetitions of the "*Gladius*" of ancient Italy and "*Xiphias*", the name by which Aristotle, the father of zoology, called the same fish twenty-three hundred years ago. The French "*Empercur*" and the "*Imperador*" and "Ocean King-fish" of the Spanish and French West Indies carry out the same idea; the Roman emperor was always represented holding a drawn sword in his hand. The Portuguese names are *Agulha* and *Agulhao*, meaning "needle" or "needle-fish".

3.—ZOOLOGICAL NAMES OF THE SWORD-FISH—WITH SYNONYMY.

Zoological names.

This species has been particularly fortunate in escaping the numerous redescrptions to which almost all widely distributed forms have been

subjected. By the writers of antiquity it was spoken of under its Aristotelian name, and in the tenth edition of his *Systema Naturæ*, at the very inception of binomial nomenclature, Linnæus called it *Xiphias gladius*.* By this name it has been known ever since, and only one additional name is included in its synonymy, *Xiphias Rondeletii*, Leach. In the following table of synonyms, references are given to the principal descriptions and figures in the standard ichthyological works:

XIPHIAS GLADIUS, Linnæus.

Xiphias gladius, LINNÆUS, *Systema Naturæ*, 10th ed. 1758, i, p. 248; 12th ed.

1766, iii, p. 432 ("habitat in oceano Europæ").

BLOCH, *Ichthyologie*, iii, 1786, pl. lxxvi, p. 23 (habits from statements of Chevalier Hamilton).

GMELIN, *Linn. Syst. Nat.* 1788, p. 1149 (includes also under (β) the American *Histiophorus*).

WALBAUM, *Artedi, Genera Piscium*, 1792, p. 207.

LACÉPÈDE, *Hist. Nat. Poiss.* 2d ed. 8vo. 1819, i, p. 538, fig. 2, pl. 24 (grotesque figure).

SCHNEIDER, *Bloch's Systema Ichthyologiæ*, 1801, p. 93 (mentions occurrence in Baltic).

SHAW, *Zoology*, 1804.

RISO, *Ichthyologie de Nice*, 1810, p. 99 (obs. on habits); *Hist. Nat. Europe Méridionale*, 1826-'27, iii, p. 208.

CUVIER, *Règne Animal*, 1st ed. 1817, p. 326; 2d ed. 1829, p. 200; *Griffith's ed.* 1834, p. 187, pl. xxvii, figs. 1, 2 (taken from CUV. & VAL. *Hist. Nat. Poiss. q. v.*); *Suppl.* p. 349.

SCORESBY, in *Edinburgh Phil. Journ.* iii, p. 411 (vessel struck by Swordfish).

FLEMING, *British Animals*, 1828, p. 220, and in *Brewster's Journal*, ii, p. 187 (specimen taken in the Tay).

CUVIER & VALENCIENNES, *Hist. Nat. Poiss.* viii, 1833, p. 255, pls. ccxxv (figure of young of 12 to 18 inches length), ccxxvi (fig. of adult).

JENYNS, *British Vertebrates*, 1835, p. 364.

YARRELL, *History of British Fishes*, 1st ed. 1836, p. 143 (fig. of young); 2d ed. p. 164 (fig. of young).

RICHARDSON, *Fauna Bor. Amer.* 1836, pp. 78, 81 (denies its existence in the Western Atlantic).

WILSON, *Encyclopedia Britannica*, art. Ichth. p. 184, pl. ccii.

PARNELL, *Fishes of the Firth of Forth*, 1838, p. 55.

STORER, *Report on the Fishes of Massachusetts*, 1839, p. 51: *Memoirs American Academy of Sciences*, p. 36; 1853, p. 149: *Synopsis of the Fishes of North America*, 1846, p. 95: *History of the Fishes of Massachusetts*, 1867, p. 71, pl. xiii, fig. 2.

DEKAY, *Zoology of New York, Fishes*, 1842, p. 111, pl. xxvi, fig. 79.

LOWE, *Trans. Zoological Society London*, iii, 1849, p. 5.

GUICHENOT, *Exploration Scientifique de l'Algérie, Poissons*, 1851, p. 60.

GÜNTHER, *Cat. Fish. Brit. Mus.* ii, 1860, p. 571; *Fische der Südsee*, i, 1873-'75, p. 105: *Study of Fishes*, 1860, pp. 173, 431 (cuts), and article *Ichthyology*, *Encyc. Britannica*, vol. xii: *Journ. Mus. Godeffroy*, part ii, p. 170, fig.

GILL, *Cat. Fish. E. Coast N. A.* 1861, p. 38: *Canadian Naturalist*, 1865, p. 250; *Cat. Fish. E. Coast N. A.* 1873, p. 24: and in *Rep. U. S. C. F. i*, 1873, p. 802.

*Linné, *Systema Naturæ*, 10th ed. 1758.

XIPHIAS GLADIUS, Linnæus.

- POEY, Syn. Piscium Cubensium, ii, 1868, p. 379 (*Xyphias gladius*).
 STEINDACHNER, Sitzb. Ak. Wiss. Wien. 1868, p. 396 (measurement of a Spanish specimen).
 HECTOR, Trans. New Zealand Institute, vii, 1873, p. 246 (occurring at Auckland) (*Ziphius gladius*).
 HUTTON, Trans. New Zealand Inst., vii, 1874, p. 211 (second occurrence at Auckland).
 CHEESEMAN, Trans. New Zealand Inst., viii, 1875, p. 219 (*Ziphius gladius*, measurements of specimens from Shelly Bay, Auckland).
 GOODE, Cat. Fishes Bermudas, 1876, p. 45.
 GOODE & BEAN, Cat. Fish. Mass. Bay, 1879, p. 14.
 GIGLIOLI, Catalogo Esp. Internat. di Pesca. Berlin, 1880, p. 88.
 LÜTKEN, Vid. Selsk. Skr. 5te Række, Naturv. og math. Afd. xii, 6 (*Spolia atlantica*), pp. 441, 592, figs. 1, 2, 3, pl. ii, fig. 10 (notes upon the young of *Xiphias gladius* and related species).
 STEINDACHNER, Sitzb. Ak. Wiss. Wien, 1868, p. 396.
 HUTTON, Trans. New Zealand Inst., viii, 1873, p. 211.
Xiphias Rondeletii, LEACH, Mem. Wernerian Nat. Hist. Society, ii, 1818, p. 58.

4.—POPULAR NAMES OF ALLIED AMERICAN SPECIES.

The Sword-fish has been so long and so well known that its right to its peculiar name has seldom been infringed upon. The various species of *Tetrapturus* have sometimes shared its title, and this is not to be wondered at, since they closely resemble *Xiphias gladius*, and the appellation has frequently been applied to the family *Xiphiidæ*—the Sword-fish family—which includes them all.

The name Bill-fish, usually applied to the *Tetrapturus albidus*, a fish of the Sword-fish family often taken on our coast, and described below, is objectionable, since it is in many districts used for the various species of *Belonidæ*, the "Gar-fishes" or "Green-bones" (*Belone truncata* and others), which are members of the same fauna. Spear-fish is a much better name, and is recommended for adoption.

The "Sail-fish", *Histiophorus americanus*, is called by sailors in the south the "Boohoo" or "Woohoo". This is evidently a corrupted form of "Guebucu", a name, apparently of Indian origin, given to the same fish in Brazil. It is possible that the *Tetrapturus* is also called "Boohoo", since the two genera are not sufficiently unlike to impress sailors with their differences. Bleeker states that in Sumatra the Malays call the related species, *H. gladius*, by the name Joohoo (*Juhu*), a curious coincidence. The names may have been carried from the Malay Archipelago to South America, or vice versa, by navigators.

In Cuba the Spear-fishes are called *Aguja* and *Aguja de Paladas*; the Sail-fish, *Aguja prieta* or *Aguja voladora*; *Tetrapturus albidus* is specially known as the *Aguja blunca*, *T. albidus* as the *Aguja de Casta*.

In the West Indies and Florida the Scabbard-fish or Silvery Hair-tail (*Trichiurus lepturus*), a form allied to the *Xiphias*, though not resembling it closely in external appearance, is often called "Sword-fish". The

body of this fish is shaped like the blade of a saber, and its skin has a bright metallic luster like that of polished steel; hence the name.

The various species of Sticklebacks, *Gasterosteus aculeatus*, *G. novaboracensis*, and *Pygosteus occidentalis*, are known as "Little Sword-fish" by the boys of Portland, Me., and vicinity. The spines, damaging in the extreme to small fingers of tyro fish-gatherers, give reason to the name.

Sail-fish appear to occur throughout the tropical and southern parts of the Atlantic and the Indian Ocean. Their names, wherever they are found, point to its most striking characters. In Marcgrave's time the Portuguese of Brazil called it *Bicuda*, referring to its snout, and Rochefort, in his History of the West Indies, calls it the *Bécasse de Mer*; a *bécasse* being a long-snouted bird like a woodcock or a snipe, while in the Malay Archipelago the Dutch call it *Zee-snip* or "Sea-snip". The Malays of Amboyna called it the *Ikan-layer* or Fan-fish, in allusion to the fan-like movements of its dorsal fin, while those of Sumatra called it *Ikan-jegan* or Sail-fish. The French *Voilier* and the Dutch *Zeyl-fisch* and *Bezaan-fisch* mean the same; a *bezaan* being the sail upon the mizzen mast of a ship. The names "Boohoo" and "Woohoo" have already been referred to. The Tamil name used about Madras, South Hindoo-stan, is "*Myl-meen*", signifying "Peacock-fish".

C.—DESCRIPTIONS OF THE SWORD-FISH FAMILY, WITH ITS SUBFAMILIES AND GENERA, WITH NOTES UPON THE AMERICAN SPECIES.

5.—DESCRIPTION OF THE FAMILY XIPHIIDÆ.

Family XIPHIIDÆ, Agassiz.

Xiphioides, AGASSIZ, Recherches sur les Poissons Fossiles, v, 1843, p. 89.—BLEEKER, Enum. Sp. Pisc. 1859, p. 62.

Xiphiidæ, GÜNTHER, Catalogue of the Fishes in the British Museum, ii, 1860, p. 511; Fische der Südsee, i, 1873-5, p. 105; Study of Fishes, 1880, p. 431.—GILL, Arrangement of the Families of Fishes, 1872, p. 8 (name only).—DAY, Fishes of India, i, 1876, p. 198.

Diagnosis of Family.

Scombroid fishes, with elongate, compressed bodies, naked (*Xiphiinæ*) or covered with elongate scale-like scutes (*Tetrapturinæ*). Premaxillaries with nasal and vomerine bones, produced in a long spear-like snout, immovably articulated with the prenasal and maxillary. Teeth absent (*Xiphiinæ*) or rudimentary (*Tetrapturinæ*). Nasal bone cellular at its base. Ventrals absent (*Xiphiinæ*) or rudimentary (*Tetrapturinæ*). A single dorsal, extending nearly the whole length of the body in young, becoming with age subdivided into two short dorsals (*Xiphiinæ*), or persistent (*Histiophorus*) or subpersistent, divided in middle with age (*Tetrapturus*). A similar rudimentation of anal fin in both subfamilies. Preopercular spine present in young (*Xiphiinæ*) or parietal and preopercular spines (*Tetrapturinæ*), disappearing with age. Seven branchiostegals. Pseudobranchiæ present. Branchiæ cancellated or reticu-

lated. Air-bladder present, simple (*Xiphiinæ*) or cellulated (*Tetrapturus* and *Histiophorus* (?)). Intestine long, sinuous (*Xiphiinæ*), or short, not sinuous (*Tetrapturinae*). Gall-bladder free, hanging at some distance from the liver. Articular processes developed from the parapophyses.

Synopsis of subfamilies.

Ventrals absent, skin scaleless, snout flat, caudal keel single... XIPHIINÆ, Swainson.

Ventrals present, skin with scutes, snout rounded, caudal keels double.

HISTIOPHORINÆ, Lütken.

6.—DESCRIPTION OF THE SUBFAMILY XIPHIINÆ AND THE GENUS XIPHIAS.

Subfamily XIPHIINÆ, Gill.

> *Xiphiinae*, SWAINSON, Nat. Hist. Fish. Amphib. etc. 1839, p. 239.

> *Xipheini*, BONAPARTE, Cat. Metod. Pesci Europei, 1846, p. 80.

Xiphiinae, GILL, Canadian Naturalist, 1867, p. 250.

Diagnosis of subfamily.

Xiphiid fishes, with bodies somewhat compressed, scaleless, or in young state covered with rough granulations. Sword flattened horizontally. Teeth absent. Pectorals sublateral. Pelvic arch and ventrals absent. A keel upon each side of the caudal peduncle. Air-bladder simple. Intestine long, sinuous. A single genus, XIPHIAS, L.

Genus *Xiphias*, Artedi.

Xiphias, ARTEDI, Genera Piscium, 1738, p. 29.

Xiphias, LINNÆUS, Syst. Nat. ed. x, 1758, p. 248; ed. xii, p. 432.

Xiphias, CUVIER, Règne Animal, 1817, p. 326, 1829, p. 200.

Xiphias, GÜNTHER, Cat. Fish. Brit. Mus ii, p. 511.

Diagnosis of genus.

Xiphiine fishes, with two dorsal fins in adult condition, the continuous dorsal of the young having become rudimentary in its median portion. Preoperculum spineless in adult, the large spine of the young disappearing at an early age. Teeth absent "except upon the pharyngeal bones, which are covered with a villosity of extremely fine and minute denticles" (*Owen*). Number of dorsal rays probably variable. Vertebrae 26 (*Steindachner*). Branchiostegals 7. Stomach siphonal, pyloric cæca very numerous. Gall-bladder large.

HABITAT.—Tropical and temperate parts of the Atlantic, Mediterranean, New Zealand, and South Pacific north to California.

A single species of this genus is now known, *Xiphias gladius*, L. The species recorded in GÜNTHER'S Catalogue of the Fishes in the British Museum, vol. ii, p. 512, under the name *Xiphias velifer*, if not mythical, is probably a *Histiophorus*. Lacépède's figure represents it with two caudal carinæ, and, what is stranger, without ventrals.

7.—DESCRIPTION OF THE SUBFAMILY HISTIOPHORINÆ AND THE GENERA TETRAPTURUS AND HISTIOPHORUS.

Subfamily HISTIOPHORINÆ, Lütken.

Tetrapturina, Gill in Rep. U. S. F. C. i, 1873, p. 787 (name only; no description).

Histiophorina, Lütken, Vid. Med. Nat. Forew., 1875, p. 18.

Diagnosis of subfamily.

Xiphiid fishes, with bodies much compressed, covered with elongate, scale-like scutes. Sword rounded at edges, spear-like. Tooth-like granulations upon the jaws. Pectorals lateral. Pelvic arch present. Ventrals present, slender, elongate. Dorsal fin single (*Histiophorus*) or in two portions, but little remote, separated by aborted section (*Tetrapturus*). Preopercular spine absent (but probably present in young). Two keels upon each side of caudal peduncle. Ultimate dorsal and anal rays suctorial. Air-bladder very large, sacculated, consisting of numerous separate divisions. Intestine short, straight.

Synopsis of genera.

Dorsal fin double, *Xiphias*-like, ventral rays anchylosed.....*Tetrapturus*, Rafinesque.
Dorsal fin single, high, sail-like, ventral rays separate.....*Histiophorus*, Lacépède.

Genus *Tetrapturus*, Rafinesque.

Tetrapturus, RAFINESQUE, Caratteri, etc. 1810, p. 54, pl. 1, fig. 7.

"*Tetrapterurus*, BONAPARTE."

Tetrapterus, AGASSIZ, Poiss. Foiss. v, 1843, p. 7.

Diagnosis of genus.

Xiphiid, tetrapturine fishes, with body much compressed. Two dorsal and two anal fins in adult state; single dorsal and anal in immature ages. Tooth-like asperities on palatines and lower jaw. Body covered with cultriform scale-like scutes, under epidermis. Dorsal rays much more numerous than in *Xiphias*, less so than in *Histiophorus*. Ventrals rudimentary, consisting of one pair of very elongate, flattened rays. Vertebrae 24 (*T. belone*). Pyloric caeca very numerous. Intestine short, nearly straight, making only about two foldings.

HABITAT.—Mediterranean; tropical and subtropical seas.

Genus *Histiophorus*, Lacépède.

< *Istiophorus*, LACÉPÈDE, Hist. Nat. Poiss. iii, 1803, p. 374.

< *Histiophorus*, CUVIER & VALENCIENNES, Hist. Nat. Poiss. viii, 1831, 291.

< *Histiophorus*, GÜNTHER, Cat. Fish. Brit. Mus. ii, 1860, p. 512.

"*Notistium*, HERMANN, Observ. Zool. 1804, p. 305."

Diagnosis of genus.

Xiphiid, tetrapturine fishes, with body slender and very much compressed. Dorsal single (though the last few rays are nearly abortive), retaining the character of extreme youth, which is lost in *Xiphias* and *Tetrapturus*, and very lofty. Vertebrae 24 (*H. indicus*). Anal fin double. Numerous tooth-like asperities on the jaws. Body covered with elon-

gate scales. Dorsal rays, being unaborted, very numerous. Ventrals consisting each of two or three elongate rays. Intestine short, nearly straight, with two foldings.

HABITAT.—Tropical and subtropical seas.

8.—DESCRIPTIVE NOTES ON THE SWORD-FISH, XIPHIAS GLADIUS.

My notes fail to supply the necessary data for a full description of the species, and since the fish is not likely by any one to be confounded with any other, I do not think it necessary to defer publication until these data can be obtained. I append the following note upon a small specimen, and also partial measurement table for two others, the dimensions in one case in inches, in the other in millimeters.

A specimen taken off Seaconnet, July 23, 1875. Weight 113 pounds; extremity of sword gone. One of the smallest ever seen in this region. Dorsal fin in its median part nearly destroyed, but traces of the groove and spines remaining.

Color.—Above rich purplish blue, shading into whitish beneath the sides, and belly with a silvery luster. Fins bluish dark with silvery sheen, except dorsal. Top of the head rich purplish blue, the color extending upon the rostrum. Lower side of rostrum rich brownish purple. Eye deep blue. No trace of scales.

Viscera.—Liver greenish light brown. Stomach siphonal; pyloric cæca infinite in number; intestine spiral 10 inches long when in position, 90 when stretched out. Gall-bladder large, situated on the same line with the spleen, and at same distance from the liver, connected by a duct. Air-bladder simple, large. Spermaries large, 6 inches long. Stomach contained small, fish perhaps *Poronotus*, and jaw of *Loligo Pealii*. Fluke worms in cover of stomach and air-bladder.

Table of measurements.

Current number of specimen.....	A. Seaconnet, R. I., July 23, 1875.	B. Gloucester, Mass., 1878.
Locality.....	Inches.	Millimeters.
Extreme length (tip of sword gone).....	91.00
Length to end of middle caudal rays.....	81.50	2,040
Body:		
Greatest height.....	13.50
Greatest circumference.....	35.00
Least height of tail.....		80
Head:		
Greatest length.....	37.00+
Length to tip of lower jaw.....	18.50	490
Greatest width.....	6.75
Width of interorbital area.....	4.85	170
Length of snout.....	20.00+
Length of operculum.....	5.00	150
Length of mandible.....	11.00	310
Diameter of eye.....	2.75	80
Dorsal (first):		
Distance from tip of lower jaw.....	15.50
Length of base (including first and second).....	37.00	470 (1st)
Greatest height.....	12.00	470

Table of measurements.—Continued.

Current number of specimen.....	A. Seaconnet, R. I., July 28, 1875.	B. Gloucester, Mass., 1878.
Locality.....	Inches.	Millimeters.
Dorsal (second):		
Length of base.....		80
Height at longest ray.....		75
Height at last ray.....	2.25	
Anal:		
Distance from snout.....	37.00	
Length of base.....	12.25	250
Height at longest ray.....	8.25	800
Height at last ray.....	2.25	
Caudal:		
Length of middle rays.....	3.50	160*
Length of external rays.....	16.50	650
Pectoral:		
Distance from tip of lower jaw.....	16.00	
Length.....	14.25	390
Branchiostegals.....	8	
Dorsal.....	20 (19), 2	
Anal.....	11 (X), 8	
Pectoral.....	20	
Weight (pounds).....	113	

* From end of carina.

Table of measurements.

Locality.....	Portland, Me., Aug. 15.
	Millimeters.
Extreme length.....	3,900
Length to end of middle caudal rays.....	3,750
Body:	
Greatest height.....	638
Greatest width.....	470
Greatest circumference.....	1,705
Height at origin of anal.....	520
Least height of tail.....	120
Height under second dorsal.....	220
Length of caudal peduncle.....	238
Head:	
Greatest length.....	1,570
Greatest width.....	885
Width of interorbital area.....	223
Length of snout.....	1,085 (870)
Length of operculum.....	200
Length of mandible.....	435
Diameter of orbit.....	100
Dorsal (spinous):	
Distance from snout.....	1,530
Length of base.....	500
Greatest height.....	550
Dorsal (soft):	
Length of base.....	50
Distance from snout.....	3,175
Height.....	90
Distance between dorsals.....	1,208
Anal:	
Distance from snout.....	2,538
Length of base.....	330
Distance of second anal from snout.....	3,125
Height at longest ray.....	340
Caudal:	
Width at caudal carina.....	500
Length of external rays.....	730
Tip to lip of caudal.....	1,140
Pectoral:	
Distance from snout.....	1,508
Length.....	532
Weight, about (pounds).....	600

Steindachner has given the following measurements of two specimens obtained by him on the coast of Spain, the largest 3 feet 7 inches in length, the smallest much younger and corresponding to the young specimen figured by Cuvier and Valenciennes in the *Histoire Naturelle des Poissons*, pl. 225.*

Table of measurements.

	A.	B.
	Inches.	Inches.
Total length.....	48.0	24.6
Length of head.....	20.7	9.7
Length of intermaxillary from anterior margin of eyes.....	15.6½	8.0
Length of mouth-opening from point of intermaxillary to posterior end of upper jaw.....	17.2	1.1½
Breadth of forehead.....	1.9	8.0
Length of under jaw.....	6.0	2.3½
Height of body.....	4.0	8.6½
Length of pectoral.....	5.8	6.2
Height of dorsal at first cleft rays.....	6.2	3.1½
Greatest height of dorsal.....	14.4	1.11
Length of base of dorsal.....	3.4	4.6
Height of anal.....	3.4	
Length of base of anal.....	4.6	

The following measurements were taken by T. F. Cheeseman, esq., F. L. S., from a specimen stranded in January, 1875, at Shelly Beach, Auckland, New Zealand :

	Feet.	Inches.
Total length from tip of snout to end of caudal fin.....	11	3
Length of snout from tip to center of eye.....	8	11½
Length of snout from tip to gape.....	4	1
Length of snout from tip to free edge of operculum.....	4	6
Length of snout from tip to nostrils.....	8	7
Length of lower jaw from point to gape.....	0	11
Projection of upper jaw over lower.....	3	2
Height of dorsal fin.....	1	3
From dorsal to caudal.....	4	0
Length of pectoral fins.....	1	5
Length of anal.....	0	8
Height of second dorsal.....	0	2½
From anal to caudal.....	1	8
Width across the tail.....	2	3
Girth just behind the eyes.....	2	11
Girth behind dorsal.....	4	8
Girth behind caudal.....	0	11
Diameter of eye.....	0	3

The extreme point of the snout was broken off, about three inches being wanting.†

9.—DESCRIPTIVE NOTES ON THE SPEAR-FISH, TETRAPTURUS ALBIDUS.

The following description was drawn up from a fine specimen of the Spear-fish taken at Block Island, R. I., in 1875 :

A male fish of 2,150^{mm} (84.646 inches), ordinary size.

Body elongated, nape elevated, bringing the greatest height over the

* Sitzb. Ak. Wiss. Wien. 1868, p. 396.

† Transactions New Zealand Institute, viii, 1875, p. 219.

operculum (10.27 inches). At the point of the pectoral the height is nine-elevenths of that at the operculum (8.4 inches), and is contained about 10 times in total length.

The head from extremity of lower jaw is contained in the total length 4 times (21.161 inches). The eye is situated midway between operculum margin and tip of lower jaw. The length of the bill beyond lower jaw equals greatest height of head. Palatines with a narrow band of rough denticulations. Asperities on the lower jaw. Bill extremely hard, especially at its extremity; its form is depressed, its edges rounded, its height greater than half its width. Preoperculum situated far back; commences midway between the eye and the opercular margin. The other opercular bones are not visible in fresh specimen.

Lateral line marked by a series of minute apertures on a continuous band, connected at the top of operculum; continues backward in a straight line for a short distance, then bends downward and reaches the middle line of the body at the point of the pectoral. Scales bony, linear, absent from the head, except on the cheeks. Those of lateral line not pierced. All the scales covered by epidermis.

Br. 7; D. 3, 39-6; A. 2, 13-6; P. 19; V. 1, 4; C. 12.

All the rays osseous, not articulated; those indicated as osseous are only distinguished from the others by their terminating in a point, which is not free. The others are flattened towards the extremity and frayed at the ends. The two first anal and three first dorsal rays are ossified to each other and upon the ray behind them, so that they appear to sight and touch as if only a single ray. Dissection shows that the first dorsal is very small (20^{mm}); second, 2½ times as high (50^{mm}); third, 115^{mm}; the fourth twice as long. The same in anal. First, 30^{mm}; second, 70^{mm}; third like fourth dorsal in form. These fins are for the most part hidden in the furrows, and their last rays are extremely short, so that it is necessary to lay them bare by dissection.

First ray of second dorsal and second anal flat and striated; these fins are crenated. The fourth of first dorsal and third of first anal touch the summits of the fins, which are slightly rounded.

First ray of pectoral very strong and prolonged to the extremity; 8 last short, forming the subbrachial dilation.

Ventral appears at first sight a single ray, but dissection shows 5, the 3 first ankylosed. They are received in a furrow, which extends to the anus.

Caudal stiff; bifurcation making angle of 72° from middle of the two caudal crests to the point of the lobes, and, neglecting points, 80°.

Origin of first dorsal above preopercle, its height surpassing by one-sixth the height of the body beneath it.

Pectoral one-eighth length of body from point of lower jaw.

First anal lower than dorsal.

The two others are small and opposite. The second dorsal a little farther back, a little higher, and a little more "échancrée".

Color.—Pronounced deep blue above, a little lighter on the flanks, passing into white below. Fins intense blue; second anal and outside of pectoral lighter. First dorsal with rounded spots, more intense, of same color. Iris clear blue; cornea blackish.

Four gills of double structure and an accessory, reticulated as in *Xiphias*.

Pylorus attached high up and has great longitudinal folds; also the duodenum, which is swollen and receives, by two openings, the secretions of the compact and glandulous mass which covers it.

Intestine slender, with two short convolutions, embracing in its last the spleen.

Swim-bladder cellulous, showing great puffs, which extend far behind the anus.

A second specimen, the measurements of which are given below (B), suggested the following notes:

Top of head and body, upper lobe of caudal fin, and caudal cartilage bluish black. Belly and throat white. Checks and opercular blackish, covered with a pearly sheen. The black hue of the back shades into the white of the belly through an insensible gradation of lines, the most prominent of which are rich purplish brown and light smoky gray. The belly and the sides are pearly up to the lateral line. The boundary between the colors of the back and the belly is indicated by an indistinct line, which may be traced from the base of the rostrum over the top of the orbit and the operculum, then descending across the lateral line at a point above the middle of the pectoral fin; it then rises in the arc of a circle above the lateral line, which it meets again at the tail, the distance between them being the greatest over the anal fin. The lower lobe of the caudal is blackish, with a pearly sheen. The ventrals and second dorsal fins are blue-black. The anterior rays of the first dorsal are also blue-black, the membrane being light bluish purple, irregularly spotted with circular dots from one-quarter to one-half an inch in diameter. The first anal is deep bluish purple at its extremity, but on its basal half bright pearly white. The inner surface of the pectoral is bluish purple, brightest in the axil; its outer surface is blackish, though completely covered with a pearly sheen.

The ventrals, first dorsal, and first anal, when not erected, are completely hidden in grooves. The second dorsal and second anal are not so hidden. The pectorals are flat, closely clinging to the sides when not in motion; their base received into a depression in the side of the fish.

The lanceolate scales may be seen through the epidermis, giving a reticulated appearance to sides of the fish.

The second dorsal and the second anal have broad, flattened, ultimate rays, which adhere closely to the body of the fish.

Measurements.

Current number of specimen	A. New Bedford, Mass., July, 25, 1875.	B. Wood's Holl, Mass., 1875.
Locality	Inches.	Inches.
Extreme length.....	80.00	89.00*
Length to end of middle caudal rays	70.50	81.00
Body:		
Greatest height.....	9.00	11.50†
Height at ventrals.....	9.00	9.00‡
Head:		
Greatest length.....	27.00	28.75
Greatest width.....	5.00	
Width of interorbital area.....	4.25	
Length of snout.....	17.50	19.50
Length of bill.....		12.25§
Length of operculum.....	3.00	
Length of upper jaw to commissure of jaws.....		22.75
Length of lower jaw to commissure of jaws.....		10.50
Distance from snout to orbit.....	17.50	
Diameter of orbit.....	2.00	2.00
Dorsal:		
Distance from snout.....	26.00	28.00
Length of base.....	40.00	37.00
Greatest height.....		12.25
Height at first spine.....	11.50	
Height at second spine.....	11.75	
Height at third spine.....	11.00	
Height at fourth spine.....	10.75	
Height at fifth spine.....	10.50	
Height at sixth spine.....	9.00	
Height at seventh spine.....	7.25	
Height at eighth spine.....	5.00	
Height at ninth spine.....	5.75	
Height at tenth spine.....	4.50	
Height at eleventh spine.....	3.50	
Height at twelfth spine.....	3.50	
Height at thirteenth spine.....	3.00	
Height at fourteenth spine.....	2.50	
Anal:		
Distance from snout.....	49.00	54.00
Length of base.....	15.00	10.25¶
Height at first spine.....	7.50	
Height at second spine.....	7.50	
Height at third spine.....	6.75	
Height at fourth spine.....	6.00	
Height at fifth spine.....	5.50	
Height at sixth spine.....	2.75	
Height at seventh spine.....	.80	
Height at eighth spine.....	.50	
Height at ninth spine.....	.85	
Height at tenth spine.....	.25	
Height at eleventh spine.....	.10	
Height of fin above sheath.....		7.25
Caudal:		
Length of middle rays.....	2.00	
Length of external rays.....	16.00	
Distance between lobe tips.....		24.25
Pectoral:		
Distance from snout.....	28.50	29.00
Length.....	14.75	18.50
Ventral:		
Distance from snout.....		30.50
Length of groove from base of ventrals to vent.....	10.00	18.50
Dorsal.....	40 + 6	39 + 5
Anal.....	11 + 6	14 + 6
Caudal.....	6 + 4 + 4 + 5	
Pectoral.....		20
Ventral.....	18	1
Weight, dressed (pounds).....	1	
Number of vertebrae:	55‡	
Dorsal.....	11	
Caudo-lumbar.....	18	

* To vertical from upper caudal lobe.
 † At origin of dorsal.
 ‡ Over vent.
 § Beyond tip of lower jaw.
 ¶ "Length of anal groove."

10.—POEY'S DESCRIPTIONS OF *TETRAPTURUS ALBIDUS* AND *TETRAPTURUS AMPLUS*.

It is quite probable that the larger species of *Tetrapturus*, *T. amplus*, Poey, which frequents the waters of Cuba, in company with the species now so often seen on our coast, may yet be found on the coast of the United States. It seems desirable, therefore, to quote here, in full, translations of the original descriptions. These species should both be critically compared with the *Tetrapturus Georgii*, described by the Rev. H. T. Lowe from Madeira.*

"It is very strange that the fishes known at Havana by the names *Aguja* and *Aguja de Paladar* have never been described in ichthyological works. Their size would naturally attract the attention of travelers, and since they are very common for four months in the year it would have been very easy to obtain them. Their flesh is palatable and always wholesome. They may have been confounded with *T. belone* of the Mediterranean, especially since the *Xiphias gladius*, here known as the *Emperador*, is often taken in our waters.

It is only necessary to glance at the figure of *T. belone* given by Cuvier and Valenciennes, and to carefully follow the description, to be satisfied that it is another species. The *Histiophorus americanus*, which we call *Aguja prieta* or *Aguja voladera*, is also found on our shores. Of the true *Tetraptures* we have two species, very distinct, the *Aguja blanca* (*Tetrapturus albidus*) and the *Aguja de Casta* (*Tetrapturus amplus*).

Tetrapturus albidus is abundant during the month of June and up to the middle of July; some are taken in August. The ordinary weight is 40 pounds, though they are sometimes taken of 100 pounds weight.

Tetrapturus amplus makes its appearance at the end of July, and is most abundant during August. Its ordinary weight is 200 to 300 pounds, but it reaches a much greater size, and is often taken weighing 400 to 500 pounds, and even 800.

The males are the smaller. These two species swim at the depth of 100 fathoms. They journey in pairs, shaping their course toward the Gulf of Mexico, the females being full of eggs.

Only adults are taken. It is not known whence they come, where they breed, or how the young return; it is not even known whether the adult fishes return by the same route.

When the fish has swallowed the hook it rises to the surface, making prodigious leaps and plunges; exhausted at last, it is dragged to the boat, secured with a boat-hook, and beaten to death before it is hauled on board.

Such fishing is not without danger, for the *Tetrapture* sometimes rushes upon the boat, drowning the fisherman or wounding him with his terrible weapon.

The fish becomes furious at the approach of sharks, which are its

* Proceedings Zoological Society of London, 1840, p. 36; Transactions Zoological Society of London, iij, 1840, p. 3.

natural enemies. They engage in violent combats, and when the *Tetrapture* is attached to the fisherman's line it often receives frightful wounds from its adversary.

The ovaries are large; the ova are small and yellow, and nearly one-eighth of an inch in diameter.

The Cuban fishermen agree in admitting under the name *Aguja blanca* two species, one called *Cabezona* (large-headed); the other smaller, the nape lower. I agree with them to some extent; yet, although I have drawn and measured many individuals of the two kinds, I do not dare to describe them as distinct, since I find remarkable variations, which lead me to suspend my judgment. I only describe one individual from those considered the large-headed variety."

For the more technical part of the description of these two species see paragraph 64.

11.—NOTES ON THE SAIL-FISH, *HISTIOPHORUS AMERICANUS*.

Strange as it may seem, the American species of *Histiophorus* has never been studied by an ichthyologist, and no attempt has ever been made to describe it or to compare it carefully with the similar species occurring in the Indian Ocean. The identity of the two has been assumed by Dr. Günther,* but since no American specimens have ever been seen by this authority, I hesitate for the present to follow his lead.

The history of the Sail-fish in ichthyological literature is as follows:

The first allusion to the genus occurs in Piso's "Historia Naturalis Brazilæ," printed at Amsterdam, in 1648. In this book † may be found an identifiable though rough figure of the American species, accompanied by a few lines of description, which, though good, when the fact

* Catalogue of the Fishes in the British Museum, ii, 1860, p. 513.

† 1648. PISO AND MARCGRAVE.

Historia Naturalis | Brasiliæ, | Auspicio et Beneficio | Illustrata. | Mauritii Com. Nassau | illius Provinciæ et Maris summi Præfecti Adornata: | In qua | Non tantum Plantæ et Animalia, sed et In- | digenarum morbi, ingenia et mores describuntur et | Iconibus quægentus illustrantur | (Elaborate engraved title-page, upon which the preceding inscription is inserted upon a scroll, the following upon a shell.) Lvgyn Batauorum, | Apud Franciscum Hackium, | et | Amstelodami, | Apud Lud. Elzevirium. 1648. | pp. (12) 122 (2) (8) 293 (7).

Second title.

Guilielmi Pisonis, M. D. | Lngduno-Batavi, | de Medicina Brasiliensi | Libri Quatuor: | I. De Aëre, Aquis & Locis. | II. De Morbis Endemiis. | III. De Venenatis & Antidotis. | IV. De Facultatibus Simplicium | et Georgi Marogravi de Liebstatd, | Misnici Germani, | Historiæ Rerum Naturalium | Brasiliæ, | Libri octo: | Quorum | Tres puores agunt de Plantis. | Quartus de Piscibus. | Quintus de Avibus. | Sextus de Quadrupedibus & Serpentibus. | Septimus de Insectis. | Octavus de Ipsa Regione, & Illius Incolis. | Cum | Appendice de Tapuyis, et Chilensibus. | Ioannes de Læt, | Antwerpianus, | In ordinem digessit & Annotationes addidit, & varias ab Auctore | Omissa supplevit & illustravit. |

that they were written in the seventeenth century is brought to mind, are of no value for critical comparison. [See paragraph 64.]

The name given to the Brazilian Sail-fish by Marcgrave, the talented young German who described the fishes in the book referred to, and who afterward sacrificed his life in exploring the unknown fields of American zoology, was *Guebucu brasiliensibus*. The use of the name *Guebucu* is interesting, since it gives a clue to the derivation of the name "Boohoo", by which this fish, and probably the Spear-fishes, are known to English-speaking sailors in the tropical Atlantic.

Sail-fishes were observed in the East Indies by Renard and Valentijn, explorers of that region from 1680 to 1720, and by other eastern voyagers. No species of the genus was, however, systematically described until 1786, when a stuffed specimen from the Indian Ocean, eight feet long, was taken to London, where it still remains in the collections of the British Museum. From this specimen M. Broussonet prepared a description, giving it the name *Scomber gladius*, rightly regarding it as a species allied to the mackerel. In 1803 Lacépède established the genus *Histiophorus* for the reception of this species.

When Cuvier and Valenciennes published the eighth volume of their Natural History of Fishes, they ignored the name *gladius*, which had been given to the East Indian fish by Broussonet, redescribing it under the name *Histiophorus indicus*. At the same time they founded another species upon the figure in Piso's Natural History of Brazil, already mentioned. This they called *Histiophorus americanus*.

In a paper printed in 1833, Dr. Nardo, of Venice, proposed the establishment of a new genus allied to *Tetrapturus* and *Xiphias*, to be called *Skeponopodus*. In this he included the fish described by Marcgrave, under the name *Skeponopodus guebucu*, and also a form observed by him in the Adriatic in 1829, which he called *S. typus*. I am not aware that ichthyologist have yet learned what this may have been.*

From the time of Marcgrave until 1872 it does not appear that any zoologist had an opportunity to study a Sail-fish from America, or even from the Atlantic, yet in Günther's "Catalogue" the name *H. americanus* is discarded and the species of America is assumed to be identical with that of the Indian Ocean.†

Günther restores Lacépède's name, *H. gladius*, for the Indian species. Possibly, indeed probably, this name will be found to include the Sail-fish of our own coast. At present, however, it seems desirable to retain a separate name. To unite species from widely distant localities with-

* *Ibis*, 1833, Heft iv, pp. 415-419.

† The specimens in the British Museum are catalogued as follows:

a. Eight feet long; stuffed. Indian Ocean. Type of the species.

b. Seven feet long; stuffed. Cape of Good Hope.

c. Dorsal fin. N. S. Wales (?). Presented by Dr. G. Bennett.

d. Snout; dried.

out ever having seen them is very disastrous to a proper understanding of the problems of geographical distribution.

The materials in the National Museum consist of a skeleton and a painted plaster cast of the specimen taken near Newport, R. I., in 1872, and a drawing made of the same, while fresh, by Mr. J. H. Blake.

The occurrence of the Sail-fish is, as has been already stated, very unusual. Marcgrave saw it in Brazil as early as 1648. De la Sagra and Poey mention that it has been seen about Cuba, and Schomburgh includes it in his Barbados list. The specimen in the United States National Museum was taken off Newport, R. I., in August, 1872, and given to Professor Baird by Mr. Samuel Powell, of Newport. No others were observed in our waters until March, 1878, when, according to Mr. Neyle Habersham, of Savannah, Ga., two were taken by a vessel between Savannah and Indian River, Florida, and were brought to Savannah, where they attracted much attention in the market. In 1873, according to Mr. E. G. Blackford, a specimen in a very mutilated condition was brought from Key West to New York City.

12.—AN ENUMERATION OF THE SPECIES OF THE SWORD-FISH FAMILY.

1. XIPHIAS GLADIUS, Linn.

The synonymy of this species, with discussions of all the facts regarding it which have come within my observation, are given elsewhere in this paper. Professor Lütken, in recently published papers, has expressed the opinion that the genus *Xiphias* cannot be regarded, as has hitherto been customary, as the central type of the family *Xiphiidae*, but rather as a divergent or aberrant form, while the round-billed Sword-fish provided with ventral fins are most typical and representative of the group.*

2. TETRAPTERUS IMPERATOR (Schneider).

Xiphias imperator, SCHNEIDER, Bloch's Syst. Ichth. 1801, p. 93, pl. xxi (poor figure), founded on Duhamel, iii, p. 333, pl. xxvi, fig. 2.

Tetrapterus belone, RAFINESQUE, Caratteri Animali e Pianti della Sicilia, 1810, p. 54, pl. i, fig. 1.—CUVIER, Règne Animal, 2d ed. 1829, ii, p. 201.—CUVIER & VALENCIENNES, Hist. Nat. Poiss. viii, 1831, p. 280, pls. cccxxvii (skeleton), cccxxviii (adult fish).—BONAPARTE, Catalogo Metodico, 1846, p. 80.

Tetrapterus belone, AGASSIZ, Poissons Fossiles, 1843, v, p. 89, tab. E. (fine figure of skeleton).

Tetrapterurus belone, BONAPARTE.

Histiophorus belone, GÜNTHER, Cat. Fish Brit. Mus. ii, 1860, p. 513.

Skeponopodus typus, NARDO, Isis, 1833, Heft iv, p. 417 (Adriatic).

This species appears to be limited to the waters of the Mediterranean. It was not noticed by Linnæus, or indeed by any of the binomial writers before Schneider. In his posthumous edition of the writings of Bloch, the latter has made reference to a figure and description in Duhamel,

* 1875. LÜTKEN, CHR.

Om rundnåbides Svaerdfiske, særligt om *Histiophorus orientalis*, Schl. < Vidensk. Meddel. Naturhvit. Foren. Kjøbenhavn, 1875, pp. 1-21 + 1-5.

and has given to a fish, which he figures in plate xxi of this work, the name *Xiphias imperator*. This name was rejected by Cuvier (Règne Animal, l. c.), and has not been recognized by later writers. It seems to me, however, that Schneider has, perhaps unintentionally, yet quite intelligibly, expressed the principal differential Characters of *Tetrapturus*. By "dorso scabro" he covers the question of the scales; by "carnia caudali nulla" he refers to the absence of the single caudal carnia of *Xiphias*, while by figure and by implication in his description he admits the presence of ventral fins. His figure, though bad, is as good as most of the old figures of *Xiphias*—that in Lacépède for example.

T. imperator is said to attain the length of five or six feet, and the weight of 150 pounds. It has been taken in the Straits of Messina with the harpoon, but according to Rafinesque is very rarely seen on the coasts of Sicily, and then only in autumn, when it is following the dolphin and flying-fish, upon which it feeds. It is ordinarily seen in pairs, male and female together, and they are taken often in the nets together. Its flesh is white, but not particularly well flavored. At Messina it is call "*Aguglia imperiale* (Cuvier & Valenciennes, l. c.).

3. TETRAPTURUS INDICUS, Cuv. & Val.

Tetrapturus indicus, CUV. & VAL. Hist. Nat. Poiss. viii, 1831, p. 286 (on figure belonging to Sir Joseph Banks).

A species founded on a figure of a specimen obtained in Sumatra, communicated by Sir Joseph Banks to Broussonet, who refers to it at the end of his "Memoire sur le Volier".*

The description is worthless. It is stated by Cuvier and Valenciennes that this fish had been supposed to be the male of *Histiophorus gladius*, but that it is much more nearly related to *Tetrapturus* of the Mediterranean, though with a longer beak.

The notes accompanying the figure state that it attains the length of nine feet and the weight of 200 pounds, and was known to the Malays by the name "*Joo-hoo*".

Günther regards it as perhaps synonymous with *T. Herschelii*, Gray.†

4. TETRAPTURUS HERSCHELII, Gray.

Tetrapturus Herschelii, GRAY, Ann. Nat. Hist. i, 1838, p. 313, pl. x.—LÜTKEN, ll. c.

Histiophorus Herschelii, GÜNTHER, l. c.

This species was described from a specimen eleven feet long obtained at Table Bay, Cape of Good Hope, in 1837. The description is reproduced in the appendix, and the plate is also here presented. The type of *T. Herschelii* is in the British Museum. The United States National Museum has some fine skins, apparently of this species, brought from Mauritius by Col. Nicholas Pike, United States consul. There is no reason to doubt that this species may be the same with *T. indicus*, Cuv. & Val., just described, there being little probability that there

* Hist de l'Acad. des Sciences Paris, 1786, pp. 450-455.

† Günther, l. c. p. 513, sub. *Histiophorus Herschelii*.

are two species in waters so close together as those of Sumatra and the Cape of Good Hope.

5. TETRAPTURUS GEORGII.

Tetrapturus (Georgii), LOWE, Proc. Zool. Soc. viii, 1840, p. 36: Trans. Zool. Soc. iii, 1849, p. 3 (reprint of first).—GÜNTHER, op. cit. p. 512, foot-note.—LÜTKEN, ll. c.

This species, known at Madeira as "*Peito*", was described by Lowe thus briefly: "I am enabled to state that it forms a new and very distinct species of *Tetrapturus*, Raf., differing from *T. belone*, Raf., as described by MM. Cuvier and Valenciennes, especially in having the pectoral fins proportionately twice as long, and the body clothed with large scales of a peculiar shape and character."

Lütken believes it to be identical with the two species of the Indian Ocean just discussed, as well as with the two Cuban species. It should surely be carefully compared with the latter.

6. TETRAPTURUS ALBIDUS, Poey.

Tetrapturus albidus, POEY, Mem. Hist. Nat. Cuba, ii, 1858, p. 237, pl. xv, fig. 1; pl. xvi, figs. 2-13; pl. xvii, figs. 1, 5, 6-9, 10-11, 26: Ib. p. 258: Rep. Fis. Nat. Cuba, ii, 1868, p. 380.—GILL, Cat. Fish E. Coast N. A. 1873, p. 24.—LÜTKEN, ll. c.

7. TETRAPTURUS AMPLUS, Poey.

Tetrapturus amplus, POEY, op. cit. p. 243, pl. xv, fig. 2; pl. xvi, figs. 12-25: Rep. Fis. Nat. Cuba, ii, 1868, p. 380.—LÜTKEN, ll. c.

These two species described by Poey from Cuba, one of which, *T. albidus*, is not uncommon on the Atlantic Coast of the United States, have already been partially discussed, and a translation of Poey's description is given in the appendix. Lütken is disposed to consider them both identical with the *T. indicus* type, and it seems to me that there is as much reason for doing this as for throwing together the Sail-fishes of the Atlantic and Indian Ocean, as has been persistently done by all writers on ichthyology.

8. TETRAPTURUS BREVIROSTRIS (Günther & Playfair).

"*Histiophorus brevirostris*, GÜNTHER & PLAYFAIR, Fishes of Zanzibar, 1866, pp. 53, 145, figure."—DAY, Fishes of India, 1876, p. 199, pl. xvii, fig. 3.

Tetrapturus brevirostris, LÜTKEN, ll. c.

Histiophorus, KNOX, Trans. New Zealand Institute, ii, 1870, pp. 13-16, fig. 1.

This species, the habitat of which is given by Day as "East coast of Africa, seas of India, perhaps New Zealand", is referred by Lütken to the same species with *T. indicus* and *T. Herschelii*. Day considers it closely allied to *Tetrapturus Lessonæ*, Canestrini.

9. TETRAPTURUS LESSONÆ, Canestrini.

Tetrapterus Lessonæ, CANESTRINI, Arch. Zool. 1861, i, p. 259, pl. vii.—LÜTKEN, ll. c.—DAY, ll. c.

This species, described by Canestrini from the Mediterranean, is referred by Lütken to the general cosmopolitan type, of which *T. indicus* and *T. Herschelii* are the representations,

10. HISTIOPHORUS GLADIUS (Broussonet) Lacép.

- Scomber gladius*, BROUSSONET, Mém. Acad. Sci. 1786, p. 454, pl. x.
 > *Scomber gladius*, BLOCH, Ichthyology, pl. ccxlv: Hist. Nat. Poiss.
 > *Istiophorus gladius*, LACÉPÈDE, "iii, pp. 374-5", 2d ed. 8°, 1819, p. 542.
Histiophorus gladius, GÜNTHER, l. c. p. 513.—GILL, ll. c.
 > *Xiphias velifer*, SCHNEIDER, l. c. p. 93.
Histiophorus indicus, CUV. & VAL. l. c. p. 293, pl. ccxxix.

This species, described first by Broussonet from specimens brought from the Indies—"la mer des Indes"—by Banks, has usually been considered, perhaps rightly, by later authors as identical with the American form.

11. HISTIOPHORUS AMERICANUS, Cuv. & Val.

- Guebucu brasiliensibus*, MARCGRAVE, Hist. Brasil. 1648.
 > *Scomber gladius*, BLOCH, l. c.
 > *Histiophorus gladius*, authors.
Histiophorus americanus, CUV. & VAL. l. c. p. 303.
Skeponopodus guebucu, NARDO, Isis, Heft iv, p. 416.

The history of this species has already been detailed under paragraph

11. Lütken follows the general lead in identifying this with *H. gladius*.

12. HISTIOPHORUS ORIENTALIS, Temminck & Schlegel.

- Histiophorus orientalis*, TEMM. & SCHLEG. Fauna Japonica, Pisces, 1842, p. 103, pl. lv (specimen 7 feet long, from Japan).—GÜNTHER, op. cit. p. 514.—LÜTKEN, Vid. Med. Nat. Foren. 1875, p. 1. pl. i (specimen 7 feet $1\frac{1}{4}$ inches long, from Singapore).

In his first paper on the Sword-fishes Lütken seemed inclined to consider this a distinct species, though doubtful. In "Spolia Atlantica" he speaks of two species of *Histiophorus*, but I am unable to decide whether it is this or *H. gracilirostris* which he regards as well separated from *H. gladius*. Speaking of the occurrence of this fish in the seas of Japan, Temminck and Schlegel remark that its Japanese name is "Herivo"; that it is occasionally taken in autumn on the southwest coast of Japan, during the progress of the tunny fishery, and that its flesh is much esteemed.

13. HISTIOPHORUS IMMACULATUS, Rüppell.

- Histiophorus immaculatus*, RÜPPELL, Proc. Zool. Soc. iii, 1835, p. 187 (abstract): Trans. Zool. Soc. ii, p. 71, pl. xv: "N. W. Fische, p. 47, taf. xi, fig. 3."—GÜNTHER, l. c.—LÜTKEN, ll. c.—DAY, Fish. India, 1876, p. 199.

Rüppell's specimen came from Djetta on the Red Sea, where the Arabs caught it in a net. He regards it as rare because the Arabs had no common name for it. The specimen is preserved in the museum at Frankfort, and, if I rightly understand Dr. Lütken, is 18 inches long. Dr. Lütken unhesitatingly pronounces it the young of *H. gladius* or *H. orientalis*, considering it as being slightly older than the one figured by Cuvier and Valenciennes as *H. pulchellus*. Day mentions a specimen of this species in the Madras Museum 5 feet 9 inches long. This, to be consistent with Lütken's theory, must be regarded as a specimen in which the colors have disappeared in drying.

14. HISTIOPHORUS PULCHELLUS, Cuvier & Valenciennes.

Histiophorus pulchellus, CUV. & VAL. Hist. Nat. Poiss. viii, 1831, p. 305, pl. ccxxx.—GÜNTHER, op. cit. p. 514.—LÜTKEN, ll. c.

Cuvier and Valenciennes described under this name a specimen 4 inches long taken in the Eastern Atlantic, north of the Cape of Good Hope, probably somewhere on the west coast of Africa, by M. Raynaud. There were said to have been a great many more of the same size in the region of the Atlantic where it was taken.

Lütken regards it as the young of *Histiophorus gladius*. He uses it to complete the series of development between the small specimens described by Günther and the adult forms.

15. HISTIOPHORUS GRACILIROSTRIS, Cuv. & Val.

Histiophorus gracilirostris, CUV. & VAL. l. c. p. 308 (description of a snout from Seychelles).—LÜTKEN, ll. c.

Cuvier and Valenciennes had in their possession, and described, a beak of a Spear-fish, the breadth of which was contained 25 to 26 times in its length, and the sides of which were more rounded than in the other specimens accessible to them. This was from Seychelles. Lütken is inclined to admit this provisionally as a distinct species. Günther, on the other hand, ignores *H. gracilirostris*, but regards *H. ancipitirostris* as a possibly existing form.

16. HISTIOPHORUS ANCIPIIROSTRIS, Cuv. & Val.

Histiophorus ancipitirostris, CUV. & VAL. op. cit. p. 309.—GÜNTHER, op. cit. p. 512, note.

A snout (locality unknown), having a flattened surface, its width contained 19 or 20 times in its length. Probably a species of *Tetrapturus*.

17. MAKAIRA NIGRICANS, Lacép.

Makaira nigricans, LACÉPÈDE, Hist. Nat. Poiss. "iv, pp. 688, 689, pl. xiii, fig. 3".—CUV. & VAL. Hist. Nat. Poiss. viii, p. 287.

Xiphias makaira, SHAW, Zool. iv, Fish. p. 104.

Machæra velifera, CUVIER, Nouv. Ann. Mus. Hist. Nat. 1832, p. 43, pl. 3.—LÜTKEN, ll. c.

Xiphias vilifer, GÜNTHER, op. cit. p. 512.

This species is undoubtedly mythical. Lütken and others have pointed out the error of arranging it, as Günther has done with *Xiphias*. He suggests that in the specimens described by Lacépède the ventral rays were hidden in the ventral furrow, and unperceived. In this case, he remarks, it would be identical with *Histiophorus gracilirostris*; but, at all events, whether it has ventral fins or not, its right place is with the subfamily *Histiophorina*.

The specimen described by Lacépède was never seen by him. It was driven ashore near Rochelle, and his sole acquaintance with it was from a drawing and description given him by M. Traversay, *sous-préfet* of

that town. It seems strange that so much stress has been laid upon this description and so much discussion has been held over the true classification of a form so evidently incorrectly described.

Fossil forms.

Agassiz, in his "Poissons Fossils," has described two species of *Tetrapturus*: one, *Tetrapturus priscus* (vol. v, p. 91, tab. 31), from the London Clay, in the Isle of Shepley; the other, *Tetrapturus minor* (vol. v, p. 91, tab. 60 a, figs. 9-13), from the Lewes Crag. The types of the former are in the Paris Museum (other similar specimens are stated to be preserved in the collections of Lord Enniskellen and Sir Philip Egerton); of the latter, in the collection of Mr. Mantell.

He has also described the genus *Cælorhynchus*, from fossil fish-beaks which appear to belong to members of the Sword-fish family. These are very long, slender, tapering more gently even than in the living forms, and are hollow throughout the entire length. There are two species, distinguished by name, but not described, viz, *C. rectus* and *C. sinuatus*, both from the London Clay of the Isle of Shepley.

Four extinct species of *Histiophorus* have been described: *H. priscus*, Ag., from the London Clay, the beak of which is not known; *H. minor*, Ag., which has a deeply fluted beak; *H. robustus*, Leidy (Post-pleiocene Foss. S. Car. p. 119, *Xiphias*), which is from the Post-pleiocene of Ashley River, South Carolina, with beak much depressed, the dentigerous surface a continuous plane, separated by a deep groove; *H. antiquus* (Leidy) Cope, from the New Jersey Eocene, has also a more depressed beak, with the dentary surfaces on one plane.

At a meeting of the Boston Society, October 6, 1852, Professor Wyman exhibited three fragments of the beak of a fossil *Istiophorus*, from the Tertiary deposits at Richmond, Va.

Pælorhynchus, of the schists of Glaris, has a bill like *Xiphias*; also *Hæmorhynchus DesHayes*, first described by Agassiz as *Histiophorus DesHayes*, a Scombroïd with elongated bill.

D.—GEOGRAPHICAL DISTRIBUTION AND MOVEMENTS.

13.—EARLY ALLUSIONS TO THE SWORD-FISH IN EUROPE.

The Sword-fish was known to Pliny, who writes: "The Sword-fish, called in Greeke *Xiphias*, that is to say in Latin *Gladius*, a sword, hath a beake or bill sharp pointed, wherewith he will drive through the sides and planks of a ship, and bouge them so, that they shall sinke withall. The experience whereof is scene in the ocean, neare to a place in Mauritania called Gotta, which is not far from the river Lixos."*

Many other classical and mediæval writers made curious allusions to the Sword-fish. A very good summary of their views is given by Bloch

* Holland's Pliny, ii, p. 428.

and is here quoted. The skepticism of this author is sometimes a little too sweeping, but is in general judicious:

“This fish is found in the North Sea and the Baltic, but is rare in those waters. In the Mediterranean, however, it is very abundant. It lives for the most part in the Atlantic, where in winter it is found in mid-ocean. In spring it appears on the coast of Sicily, where its eggs are deposited on the bottom in great numbers. However, according to what I have been told by the illustrious Chevalier Hamilton, it is never seen in that region more than three or four feet long. The larger ones, often weighing four or five hundred pounds, and eighteen to twenty feet long, are found on the coast of Calabria, where they appear in June and July. Pliny remarked that they often exceed the dolphin in size. * * *

“Various writers have spoken of the ‘Emperor of the Sea’ as occurring in the Baltic. Olearius and Schelhammer record its capture near Holstein; Schoneveld mentions one from Mecklenburg; Walbaum one from the vicinity of Lübeck; Hanover and Klein one from the vicinity of Danzig; Hartmann one from near Pillau; and Wolf another taken near Königsberg.

“One mentioned by Schoneveld as taken near Mecklenburg was so large that it required two strong horses to draw it from the water. The body, without the sword, was eleven feet long, the sword three. The eyes were as large as hens’ eggs, and the tail was two feet broad. Of four seen by Professor Koelpin during his stay at Greifswald, one measured more than three and one-half feet in circumference. * * *

“These fish, according to the story of the Chevalier Hamilton, always appear in pairs as they approach Messina, a female and a male together.”

[Then follows a description of the method of capture, very similar to that given below in paragraph 56.]

“This fish lives upon marine plants and fish. It has such a terrible defensive weapon that other voracious fishes do not dare to attack it. According to Aristotle, it is, like the tunny, tormented by an insect, and in its fury leaps out of the sea and even into vessels. According to Staius Müller, the skin is phosphorescent at night. Although such large fishes are not usually well flavored, this one is considered palatable. Pieces of the belly and the tail are especially esteemed, and hence they are expensive. The fins are salted and sold under the name ‘callo’. * * *

“Aelian errs in saying that it enters fresh water, and in cataloguing it among the fishes of the Danube.

“Oppian and Ovid consider it, on account of its sword, one of the most terrible denizens of the sea. It is not at all probable that, as Pliny and many other later ichthyologists have written, it pierces the sides of vessels with its sword and sends them to the bottom; its sword is not sufficiently strong.

“Salviani, who gave the first figure of the fish, was wrong, like many writers who followed him, in giving two dorsal and two anal fins.

"Gesner, Aldrovandus, and Jonston have represented the species with two ventral fins. Bellon and Bomare were wrong in classing it among the whales. Subsequent authors have failed to find the scales represented in the figure given by the former and the teeth of which the latter spoke."*

14.—ALLUSIONS TO THE SWORD-FISH IN AMERICA BY EARLY WRITERS.

The ancient city of Siena, secluded and almost forgotten among the hills of Northern Italy, should have a peculiar interest for Americans. Here Christopher Columbus was educated, and here, in the height of his triumphs as a discoverer, he chose to deposit a memento of his first voyage across the seas. His votive offering hangs over the portal of the old collegiate church, closed for many years, and rarely visited save by enterprising American tourists. It consists of the helmet and armor worn by the discoverer when he first planted his feet on New World earth, his weapons, and the weapon of a warrior killed by his party when approaching the American coast—the sword of a Sword-fish. †

It is not probable that Columbus or some of his crew, sea-faring men of the Mediterranean, had never seen the Sword-fish. Still, its sword was treasured up by them, and has formed for more than four centuries and a half a striking feature in the best preserved monument of the discoverer of America.

The earliest allusion in literature to the existence of the Sword-fish in the Western Atlantic seems to occur in Josselyn's Account of Two Voyages to New England, printed in 1674, in the following passage:

"First Voyage:—The Twentieth day, we saw a great number of Seabats, or Owles, called also flying fish, they are about the bigness of a Whiting, with four tinsel wings, with which they fly as long as they are wet, when pursued by other fishes. Here likewise we saw many Grand-pisces, or Herring-hogs, hunting the scholes of Herrings, in the afternoon we saw a great fish called the Vehuella or Sword-fish, having a long, strong and sharp fin like a Sword-blade on the top of his head, with which he pierced our Ship, and broke it off with striving to get loose, one of our Sailers dived and brought it aboard."

A half century later the species is referred to in Catesby's work. ‡

Pennant, though aware of the statement made by Catesby, refuses the species a place in his List of the Fishes of North America, § supposing him to refer to the orca or high-finned killer-whale: "I am not certain whether *Catesby* does not mean the high-finned *Cachelot* by his Sword-

* Bloch, *Ichthyologie*, iii, pp. 24-26.

† For this fact, which I do not remember to have ever seen on record, I am indebted to my friend Col. N. D. Wilkins, of the Detroit Free Press, who visited the locality in 1879.

‡ *Historia Naturalis Carolinæ*, &c., 1731.

§ *Arctic Zoology*, vol. iii, 1784, p. 364.

fish; yet as it is found in most seas, even to those of *Ceylon* (Mr. Løten,) I give it a place here."

Catesby's testimony was soon confirmed by Dr. Alexander Garden. This enthusiastic collector, through whose correspondence with Linnæus so many of our southern plants and animals were first brought to knowledge and named, writes to John Ellis, from Charleston, S. C., March 25, 1755: "I have sent you one of the rostrums of a fish found on the Florida coast, which I take to be a species of the *Xiphias rostr. apice ensiforme, pinnis ventralibus nullis*.* I have been told that they are frequently found on the Carolina coast, though I have never seen any of them, and I have been all along the coast to the Florida shore."†

Another allusion occurs in a communication by Prof. S. L. Mitchill, of New York, in the *American Monthly Magazine* :

"An individual of this species was taken, off Sandy Hook, by means of a harpoon, on the 19th June, 1817. The next day it was brought to New York Market and cut up like halibut and sturgeon for food. The length was about 12 feet, and girth, by estimation, 5. * * * The stomach contained seven or eight mackerel. The flesh was remarkably firm; it was purchased at a quarter of a dollar the pound. I tasted a chop of it, broiled, and found it savory and excellent. It resembled the best sturgeon, without its strong and oily flavor. While I ate it I thought of veal cutlet. * * * I have been informed by my friend John Renny that a Sword-fish 16 feet long was exhibited at New York in the year 1791."‡

15.—DISTRIBUTION OF XIPHIAS GLADIUS IN THE EASTERN ATLANTIC

The Sword-fish is abundant in the Mediterranean§ even as far east as Constantinople. Aelian said that it was frequent in the Black Sea, entering the Danube. Unfortunately, this is neither confirmed nor contradicted by any later writer whose works I have seen, except Bloch, whose skepticism is as unreliable as the statements of Aelian. Aelian says that this species, with several others, is frequently taken in the Danube at the breaking up of the ice in spring. This is so contrary to the known habits of the fish that it throws discredit on the whole story, for the present at least. From the entrance to the Mediterranean they range south to Cape Town. Berthelot saw great numbers of them off the Canaries. They have been frequently noticed on the coasts of Spain and France. They occur sparingly in summer in the British waters, even to the Orkneys and the Hebrides. They occasionally reach

* The name by which this fish was designated in the earlier editions of Linnæus's writings.

† A selection of the correspondence of Linnæus and other naturalists, from the original manuscripts. By Sir James Edward Smith, M. D., F. R. S., &c., &c., president of the Linnæan Society. In two volumes. London. Printed for Longman, Hurst, Rees, Orme and Brown, Paternoster Row, 1821. (Vol. i, p. 353.)

‡ *American Monthly Magazine*, ii, 1818, p. 242.

§ Risso, Cuvier & Valenciennes, Guichenot, &c.

Sweden and Norway, where Linnæus observed them, and, according to Lütken, have been taken on the coast of Finmark. They are known to have occurred in Danish waters and to have found their way into the Baltic, thus gaining a place in the fauna of Russia. A number of instances of the occurrence of Sword-fish in the Baltic are mentioned above in paragraph 13.

16.—DISTRIBUTION ON THE COAST OF THE UNITED STATES.

Allusion has been made to the early accounts of the Sword-fish on the coast of the United States both in the work of Catesby and the letters of Garden to Ellis and Linnæus; also, to Mitchill's account of it in 1818. Though it is strange that this very conspicuous species was not recorded more frequently by early American authors, it is still more remarkable that its right to a place in the fauna of the Western Atlantic was either denied or questioned, as late as 1836, by such well-informed authors as Sir John Richardson and MM. Cuvier and Valenciennes.

Storer's "Report on the Ichthyology and Herpetology of Massachusetts", published in 1839, was the first American faunal list, after Catesby's, in which the Sword-fish was mentioned among the American fish.

The range of the species on the eastern coast of America can now be defined with some accuracy. Northward and eastward these fish have been seen as far as Cape Breton and Sable Island Banks.

Captain Rowe states that during a trip to George's Banks he has seen them off Chebucto Head, near Halifax, where the fishermen claim occasionally to have taken them with a seine.

Capt. Daniel O'Brien, of the schooner "Ossipee", took five Sword-fish on his halibut-trawl, in 200 fathoms of water, between La Have and Brown's Banks, in August, 1877.

* Richardson remarks: "The habits of the *Scomberoidæ* are quite in accordance with their great powers of natation. We found among them many fish that pass their lives remote from the land, in the middle districts of the ocean, and the family may be termed *pelagic* with as much propriety as some of the preceding ones have been named after the countries where they most abound. The bonitos and dolphins, or *Coryphææ*, especially, roam about the tropics, pursuing schools of various kinds of flying fish. There is a greater number of species that cross the Atlantic belonging to this family than to any preceding one. Among these are *Scomber griz*, *Pelamys sarda*, *Trichurus lepturus*, *Elacate atlantica*, *Lichia glaucus*, *Caranx oarungus*, and *Nomens mauritii*. Several not only traverse the Atlantic from side to side, but also range through other seas; thus, *Thynnus pelamys* and *Seriola cosmopolita* are known on both sides of the Atlantic and in the Indian Ocean. *Auxis vulgaris*, which is common to the Mediterranean and Caribbean Seas, also extends to the Indian Archipelago, if the *Taso* of New Guinea be the same species. *Vomer Brownii* visits both sides of the Atlantic, and also the sea of Peru. Many of the species mentioned above as traversing the Atlantic exist also in the Mediterranean; and there are several others which have an extensive range in the latter sea and through the whole eastern side of the Atlantic, though they do not cross to America, such as *Scomber scombrus*, *Lepidopus argyreus*, XIPHIAS GLADIUS, and *Naucrates ductor*. * * * *Xiphias gladius* is enumerated by Dr. Smith, in his list of the fish of Massachusetts; but as he has included several other European species in his list on very insufficient grounds, further evidence is required of its being an American fish."—(Richardson, Fauna Boreali-Americani, p. 78.)

Capt. Jerome B. Smith, of the schooner "Hattie Lewis", of Gloucester, killed a Sword-fish off Cape Smoke, near Sidney, Cape Breton.

Mr. J. Matthew Jones, of Halifax, N. S., writes, in 1877: "The Sword-fish is by no means common on our coast, and only makes its appearance at intervals in our harbors and bays. One was taken in 1864 in Bedford Basin, at the head of Halifax Harbor. September 6, 1866, an individual weighing 200 pounds was taken in a net at Devil's Island. November 12, 1866, the Rev. J. Ambrose sent me a sword, 3 feet and 6 inches long, from a fish taken at Dover, N. S., a few days previously."

The Sword-fish has, once at least, penetrated into the Gulf of St. Lawrence. In September, 1857, Capt. J. W. Collins was one of the crew of the schooner "Mary Ellen", of Truro, Mass., and harpooned a Sword-fish four miles southwest of the eastern part of Prince Edwards Island.

On the coasts of Maine, Massachusetts, and Rhode Island they abound in the summer months. Southward they are less frequently seen, though their occurrence off New York is not unusual. I have never known one to be taken off New Jersey, and in our southern waters they do not appear to remain. Uhler and Lugger vaguely state that they sometimes enter the Chesapeake Bay.† This is apparently traditionary evidence.

Dr. Yarrow obtained reliable information of their occasional appearance near Cape Lookout, N. C.‡

Mr. A. W. Simpson states, in a letter to Professor Baird, that Sword-fish are sometimes seen at sea off Cape Hatteras, in November and December, in large quantities. They sometimes find their way into the sounds.

An item went the rounds of the newspapers in 1876 to the effect that a Sword-fish 4 feet long had been captured in the Saint John's River, near Jacksonville. After personal inquiry in Jacksonville, I am satisfied that this was simply a scabbard-fish or silvery hair-tail (*Trichiurus lepturus*).

Professor Poey states that the fishermen of Cuba sometimes capture the *Pez de espada* when in pursuit of *Agujas* or Spear-fishes.§

They have also been seen in Jamaica.

Lütken gives instances of the capture of young Sword-fish at various points in the open Atlantic, as follows:

(1) Lat. 32° 50' N., long. 74° 19' W. (about 150 miles SE. of Cape Hatteras).

(2) Lat. 23° W., long. 55° W. (about 500 miles NE. of the Island of Antigua).

(3) Lat. 20° N., long. 31° W. (about 150 miles NW. of Teneriffe and 250 SW. of Madeira).

* Capt. R. H. Hulbert.

† List of the Fishes of Maryland. By P. R. Uhler and Otto Lugger, in Report of the Commissioners of Fisheries of Maryland, January, 1876, p. 90.

‡ Notes on the Natural History of Fort Macon, N. C., and vicinity (No. 3). By H. C. Yarrow, in Proceedings of the Academy of Natural Sciences of Philadelphia, 1877, p. 207.

§ Synopsis Piscium Cubensium, Cataloga Razonado de los Peces de la Isla de Cuba, in Repertorio Fisico-Natural de la Isla de Cuba, ii, 1868, p. 379.

(4) On the equator, long. 29° (about 500 miles NE. of Cape St. Roque).

(5) Lat. $25^{\circ} 4' S.$, long. $27^{\circ} 26' W.$ (about 500 miles S. of the Island of Trinidad, South Atlantic).

17.—OCCURRENCE IN THE PACIFIC AND INDIAN OCEANS.

We have no record of the occurrence of Sword-fishes on the eastern coast of South America, but the species is found on the Pacific coast of the same continent, and north to California.

Professor Jordan writes: "Occasionally seen about Santa Catalina and the Coronados, but never taken, the fishermen having no suitable tackle. One seen by us off Santa Monica, in 1880, about eight feet in length."

Mr. Willard Nye, of New Bedford, Mass., kindly communicates the following notes: Captain Dyer, of this port, says that Sword-fish are plentiful off the Peruvian coast, a number being often in sight at one time. The largest he ever saw was one caught by himself about 150 miles from the shore, and which he estimates to have weighed 900 to 1,000 pounds; the ship's crew subsisted on it for several days and then salted 400 pounds.

Captain Allen also states that while cruising in the Pacific for whales he has found the Sword-fish very abundant on the coasts of Peru and Chili, from the immediate coast 300 miles out, though outside of that limit they are seldom seen. They are most plenty during the month of January, when they are feeding on the common mackerel, with which those waters at that time abound. The largest he ever caught weighed about 600 pounds.

Both Captain Allen and Captain Dyer have made several voyages as masters of whaling ships, and are perfectly familiar with Sword-fish on our coast; both speak of seeing plenty of Bill-fish in the Pacific, but they never had taken the trouble to catch them. Günther mentions them in his book on the Fishes of the South Sea.

In 1874 Dr. Hector discovered a Sword-fish snout in the museum at Auckland, New Zealand, and his announcement of the discovery was followed by the publication of two other instances of its occurrence in this region.*

18.—SWORD-FISH ENTERING RIVERS.

Sword-fish have been known to enter the rivers of Europe. We have no record of such a habit in those frequenting our waters.†

* Hector, Trans. New Zealand Inst. vii, (1874) 1875, p. 246.

Hutton, *ibid.* viii, (1875) 1876, p. 211.

Cheeseman, *ibid.* p. 219.

† They sometimes approach very near the shore, however, as is shown by the following extract from a Cape Cod paper:

"A Sword-fish in close quarters.—Monday afternoon, while Mr. A. McKenzie, the boat-builder on J. S. Atwood's wharf, was busily at work, his attention was attracted by a splashing of water under his work-shop, as if a score of boys were swimming and

Aelian's improbable story that they were taken in the Danube in winter has been mentioned. Southey and others relate that a man was killed while bathing in the Severn, near Worcester, by one of these fishes, which was afterwards caught.

Couch states that a Sword-fish, supposed to weigh nearly 300 pounds, was caught in the river Parrett, near Bridgewater, in July, 1834.

According to De la Blanchère, one of them was taken, in the ninth year of the French Republic, in the river of Vannes, on the coast of Rhufs.†

In the great hall of the *Rathhaus* in the city of Bremen hangs a large painting of a Sword-fish which was taken in the river Weser by some Bremen fishermen some time in the seventeenth century.

Underneath it is painted the following inscription :

“ANNO. 1696. DEN. 18. JULI. IST. DIESER.
FISCH. EIN. SCHWERTFISCH. GENANNT. VON. DIESER.
STADT. FISCHERN. IN. DER. WESER. GEFANGEN.
UND. DEM. 20. EJUSDEM. ANHERO. NAEHER.
BREMEN. GEBRACHT. WORDEN: SEINE. GANZE.
LENGTE. WAR. 10. FUSS. DAS. SCHWERT. WAR.
7½. VIBTEL. LANG. UND. 3. ZOLL. BREIT.”

19.—GEOGRAPHICAL RANGE OF THE SWORD-FISH FAMILY.

Although it may not seem desirable at present to accept in full the views of Dr. Lütken regarding the specific unity of the Spear-fishes and the Sail-fishes of the Atlantic and Indian Oceans, it is convenient to group the different species in the way he has suggested in discussing their geographical distribution.

THE SWORD-FISH, *Xiphias gladius*, ranges along the Atlantic coast of America from Jamaica, lat. 18° N., Cuba, and the Bermudas to Cape Breton, lat. 47°. Not seen at Greenland, Iceland, or Spitzbergen, but occurring, according to Collett, at the North Cape, lat. 71°. Abundant along the coasts of Western Europe, entering the Baltic and the Mediterranean. I can find no record of the species on the west coast of Africa south of the Cape Verdes, though Lütken, who may have access to facts unknown to me, states that they occur clear down to the Cape of

making all the noise they possibly could by beating the water with their feet and hands. After this had been kept up a while his curiosity became excited, and upon investigating the cause of the disturbance discovered a Sword-fish among the, where, in his attempts to escape, he had become bewildered and imprisoned. Quickly getting a harpoon, Mr. McKenzie fastened the fish, and with the aid of bystanders drew it alive upon the wharf, where it was visited by many spectators, and subsequently dressed and sold. It measured ten feet from the end of its sword to the tip of the tail—the sword itself being three feet in length. It is the first instance known of one of these fish being so near the shore, and why it should have been there at that time described is not easily explained.”—*Provincetown Advocate*, September 29, 1875.

* History of British Fishes, ii, p. 148.

† Dictionnaire Général des Pêches.

Good Hope, South Atlantic in mid-ocean, west coast of South America and north to Southern California, lat. 34° , New Zealand, and in the Indian Ocean off Mauritius. Good authorities state that sperm-whales, though constantly passing Cape Horn, never round the Cape of Good Hope. Can this be true in the case of the Sword-fish ?

THE SAIL-FISH, *Histiophorus gladius* (with *H. americanus* and *H. orientalis*, questionable species, and *H. pulchellus* and *H. immaculatus*, young), occurs in the Red Sea, Indian Ocean, Malay Archipelago, and south at least as far as the Cape of Good Hope, lat. 35° S.; in the Atlantic on coast of Brazil, lat. 30° S. to 0, and north to Southern New England, lat. 42° N.; in the Pacific to Southwestern Japan, lat. 30° to 10° N. In a general way the range may be said to be in tropical and temperate seas, between lat. 30° S. and 40° N., and in the western parts of those seas.

THE BILL-FISH OR SPEAR-FISH, *Tetrapturus indicus* (with the various doubtful species mentioned in paragraph 12), occurs in the Western Atlantic from the West Indies, lat. 10° to 20° N., to Southern New England, lat. 42° N.; in the Eastern Atlantic from Gibraltar, lat. 45° N., to the Cape of Good Hope, lat. 30° S.; in the Indian Ocean, the Malay Archipelago, New Zealand, lat. 40° S., and on the west coast of Chili and Peru. In a general way, the range is between lat. 40° N. and lat. 40° S.

The species of *Tetrapturus* which we have been accustomed to call *T. albidus*, abundant about Cuba, is not very unusual on the coast of Southern New England. Several are taken every year by the Sword-fish fishermen. I have not known of their capture along the Southern Atlantic coast of the United States. All I have known about were taken between Sandy Hook and the eastern part of George's Banks.

THE MEDITERRANEAN SPEAR-FISH, *Tetrapturus belone*, appears to be a land-locked form; never passing west of the Straits of Gibraltar.

20.—PERIODICAL MOVEMENTS OF THE SWORD-FISH—TIMES OF ARRIVAL AND DEPARTURE.

Before entering upon a discussion of the movements of the Sword-fish and their causes, it seems desirable to bring together the facts which have been learned, by conversation with fishermen and otherwise, in one group. Each man's views are given in his own style, and as nearly as possible in his own words. There is no attempt at a classification of the facts. This will be made subsequently.

An old swordfisherman at New York informed Mr. Blackford that the season opens in the neighborhood of Sandy Hook about the 1st of June, and continues along the coast as far east as Martha's Vineyard and Nantucket Shoals until about the middle of September. He has heard of their being caught as far east as Cape Sable. At the first cold winds of September they disappear. They are, like the mackerel, at first very poor and lean, but as the season advances they grow fatter.

Mr. John H. Thomson, of New Bedford, who kindly interviewed some of the local fishermen, writes: "The Sword-fish appear on our coast, south of Block Island, about May 25 to June 1. They appear to come from the southwest, or just inside the track of the Gulf Stream. They gradually approach the Vineyard Sound and vicinity during June and until July 10 or 15, then appear to leave, working to the southeast, and are to be found to the southeast of Crab Ledge about the middle of July. This school is composed of comparatively small fish, averaging about 150 pounds, gross, or about 100 pounds without head and tail, as they are delivered in the market. The smallest are 4 feet long, including the sword, and weigh from 30 to 40 pounds; the largest $8\frac{1}{2}$ feet long, with sword, and weighing 300 pounds gross. These fish are of a light plumbeous hue, darker on the back and white on the belly.

"Of late years another school has appeared southeast of Cape Cod and George's Banks about the 1st of August. These fish are altogether different, being much larger, weighing from 300 to 800 pounds gross, and are entirely black. I have this week conversed with an old smackman, M. C. Tripp, who has all his life been a fisherman, and has this year (1874) captured about ninety fish, and his opinion is that they are not the same school. They appear to be of about the same abundance in average years, the catch depending on weather, fogs, &c. They come and leave in a general school, not in close schools like other fish, but distributed over the surface of the water, the whole being called by the fishermen the 'annual school', though it cannot strictly be so named."

According to Mr. Willard Nye, Sword-fish appear on the coast of Massachusetts from the 8th to the 20th of June, and are first seen southwest of Block Island. They begin to leave in August, but stray ones are sometimes seen as late as the last of October. The usual explanation of their movement is that they are following their food—mackerel and menhaden—which swarm our waters in the season named, and which are of course driven off by the approach of winter and rough weather.

Capt. R. H. Hurlbert took a very large Sword-fish on George's Banks, in November, 1875, in a snow-storm.

The first Sword-fish of the season of 1875 was taken June 20, southwest of Montauk Point; its weight was 185 pounds.

One taken off Noman's Land, July 20, 1875, weighed when dressed 120 pounds, and measured 7 feet. A cast was taken (No. 360), which was exhibited in the Government Building at Philadelphia.

Capt. Benjamin Ashby, of Noank, Conn., tells me that the New London and Noank vessels leave home on their swordfishing cruise about the 6th of July. Through July they fish between Block Island and Noman's Land; in August between Noman's Land and the South Shoals Light Ship. The fish "strike in" to Block Island and Montauk Point every year about the 1st of July. They are first seen 20 to 25 miles southeast of Montauk. At the end of August they are most abundant in the South Channel. Captain Ashby never saw them at any time so

abundant as August 15, 1859. He was cruising between George's Banks and the South Shoals. It was a calm day, after a fog. He could at any time see twenty-five or thirty from the mast-head. They turn south when snow comes.

Capt. George H. Martin, of East Gloucester, tells me that the Gloucester vessels employed in this fishery expect to be on the fishing grounds south of George's Banks by the 10th of June. They almost always find the fish there on their arrival, following the schools of mackerel. They "tend on soundings", like the mackerel. The first Sword-fish of 1877 was taken June 10; the first of 1878, June 14.

The statements already quoted, and numerous conversations with fishermen not here recorded, lead me to believe that Sword-fish are most abundant on the shoals near the shore and on the banks during the months of July and August; that they make their appearance on the frequented cruising grounds between Montauk Point and the eastern part of George's Banks some time between the 25th of May and the 20th of June, and that they remain until the approach of cold weather in October or early in November. The dates of the capture of the first fish on the cruising ground referred to are recorded for three years, and are reasonably reliable: 1875, June 20; 1877, June 10; 1878, June 14.

South of the cruising ground the dates of arrival and departure are doubtless farther apart; north and east the season shorter. There are no means of obtaining information, since the men engaged in this fishery are the only ones likely to remember the dates when the fish are seen.

21.—REASONS OF THE COMING OF SWORD-FISH UPON OUR COAST.

The Sword-fish comes into our waters in pursuit of its food. At least this is the most probable explanation of their movements, since the duties of reproduction appear to be performed elsewhere. Like the tunny, the bluefish, the bonito, and the squeteague, they pursue and prey upon the schools of menhaden and mackerel which are so abundant in the summer months. "When you see Sword-fish, you may know that mackerel are about!" said an old fisherman to me. "Where you see the fin-back whale following food, there you find Sword-fish!" said another. The Sword-fish also feeds upon squid, which are at times abundant on our banks.

22.—THE INFLUENCE OF TEMPERATURE UPON THE MOVEMENTS OF THE SWORD-FISH.

To what extent this fish is amenable to the influences of temperature is an unsolved problem. We are met at the outset by the fact that they are frequently taken on trawl-lines which are set at the depth of 100 fathoms or more on the off-shore banks. We know that the temperature of the water at those localities and at that depth is sure to be less than 40° Fahrenheit. How is this fact to be reconciled with the known habits of the fish, that it prefers the warmest weather of summer and swims at

the surface in water of temperature ranging from 55° to 70°, sinking when cool winds blow? The case seemed clear enough until this perplexing discovery was made, that Sword-fish are taken on bottom trawl-lines. In other respects their habits agree closely with those of the mackerel tribe, all the members of which seem sensitive to slight changes in temperature, and which, as a rule, prefer temperature in the neighborhood of 50° or more.

There is one theory by which this difficulty may be avoided. We may suppose that the Sword-fish take the hooks on their way down to the bottom; that in their struggles they get entangled in the line and hooks, and when exhausted sink to the bottom. This is not improbable. A conversation with some fishermen who have caught them in this way develops the fact that the fish are usually much tangled in the line, and are nearly lifeless when they are brought to the surface. A confirmation is found in the observations of Captain Baker, of the schooner "Peter D. Smith", of Gloucester, who tells me that they often are taken on the hand-lines of the codfishermen on George's Banks. His observations lead him to believe that they only take the hook when the tide is running very swiftly and the lines are trailing out in the tide-way at a considerable distance from the bottom, and that the Sword-fish strike for the bottom as soon as they are hooked. This theory is not improbable, as I have already remarked, but it is not at present very strongly advocated. I want more facts before making up my own mind. At present the relation of the movements of the Sword-fish to temperature must be left without being understood.

The appearance of the fish at the surface depends apparently upon temperature. They are seen only upon quiet summer days, in the morning before ten or eleven o'clock and in the afternoon about four o'clock. Old fishermen say that they rise when the mackerel rise, and that when the mackerel go down they go down also.

23.—PROBABLE WINTER HABITAT OF THE SWORD-FISH.

Regarding the winter abode of the Sword-fish conjecture is useless. I have already discussed this question at length with reference to the menhaden and mackerel. With the Sword-fish the conditions are very different. The former are known to spawn in our waters, and the schools of young ones follow the old ones in toward the shores. The latter do not spawn in our waters. We cannot well believe that they hibernate, nor is the hypothesis of a sojourn in the middle strata of mid-ocean exactly tenable. Perhaps they migrate to some distant region, where they spawn. But then the spawning time of this species in the Mediterranean, as is related in a subsequent paragraph, appears to occur in the summer months, at the very time when our Sword-fishes are thronging our own waters, apparently with no care for the perpetuation of their species.

24.—MOVEMENTS OF INDIVIDUAL SWORD-FISHES.

A Sword-fish when swimming near the surface usually allows its dorsal fin and the upper lobe of its caudal fin to be visible, projecting out of the water several inches. It is this habit which enables the fisherman to detect the presence of the fish. It swims slowly along, and the fishing schooner with a light breeze finds no difficulty in overtaking it. When excited its motions are very rapid and nervous. Sword-fishes are sometimes seen to leap entirely out of the water. Early writers attributed this habit to the tormenting presence of parasites, but this theory seems hardly necessary, knowing what we do of its violent exertions at other times. The pointed head, the fins of the back and abdomen snugly fitting into grooves, the absence of ventrals, the long, lithe, muscular body, sloping slowly to the tail, fit it for the most rapid and forcible movement through the water. Prof. Richard Owen, testifying in an English court in regard to its power, said:

“It strikes with the accumulated force of fifteen double-handed hammers. Its velocity is equal to that of a swivel-shot, and is as dangerous in its effects as a heavy artillery projectile.”

Many very curious instances are on record of the encounters of this fish with other fishes or of their attacks upon ships. What can be the inducement for it to attack objects so much larger than itself it is hard to surmise. Every one knows the couplet from Oppian:

“Nature her bounty to his mouth confined,
Gave him a sword, but left unarmed his mind.”

It surely seems as if a temporary insanity sometimes takes possession of the fish. It is not strange that, when harpooned, it should retaliate by attacking its assailant. An old swordfisherman told Mr. Blackford that his vessel had been struck twenty times. There are, however, many instances of entirely unprovoked assault on vessels at sea. Many of these are recounted in a later portion of this memoir. Their movements when feeding are discussed below, under section 35, as well as their alleged peculiarities of movement during the breeding season, under section 37.

It is the universal testimony of our fishermen that two are never seen swimming close together. Captain Ashby says that they are always distant from each other at least 30 or 40 feet.

25.—MOVEMENTS OF SPEAR-FISHES.

The Spear-fish in our waters is said by the fishermen to resemble the Sword-fish in its movements and manner of feeding. Professor Poey narrates that both the Cuban species swim at a depth of 100 fathoms, and they journey in pairs, shaping their course toward the Gulf of Mexico, the females being full of eggs. Only adults are taken. It is not known whence they come, or where they breed, or how the young return. It is not even known whether the adult fishes return by the same route.

When the fish has swallowed the hook it rises to the surface, making prodigious leaps and plunges. At last it is dragged to the boat, secured with a boat-hook, and beaten to death before it is hauled on board. Such fishing is not without danger, for the Spear-fish sometimes rushes upon the boat, drowning the fisherman, or wounding him with its terrible weapon. The fish becomes furious at the appearance of sharks, which are its natural enemies. They engage in violent combats, and when the Spear-fish is attached to the fisherman's line it often receives frightful wounds from these adversaries.

In *Land and Water* for August 31, 1872, Col. Nicholas Pike, author of "Subtropical Rambles", at that time United States consul at Mauritius, describes the habits of a species of *Tetrapturus* occurring in that vicinity. He states that they have the habit of resting quietly on the surface in calm weather, with their dorsals expanded and acting as sails. They are taken in deep water with hook and line or speared when near the surface, like Sword-fish. When hooked or speared they make for the boats, taking tremendous leaps in the air, and if care is not taken they will jump into the boats, to the great consternation of the fishermen, or else pierce the boats with their bills. The fish is highly esteemed in the Mauritius, the flesh being of a salmon color near the vertebræ; lower down it is red and like coarse beef. The species attains a large size, one having been seen measuring 26 feet.

.26.—MOVEMENTS OF SAIL-FISHES.

No observations have been made in this country, and recourse must be had to the statements of observers in the other hemisphere.

In the life of Sir Stamford Raffles there is the following account from Singapore, under date of November 30, 1822 :

"The only amusing discovery we have recently made is that of a sailing fish, called by the natives *Ikan layar*, of about 10 or 12 feet long, which hoists a mainsail, and often sails in the manner of a native boat, and with considerable swiftness. I have sent a set of the sails home, as they are beautifully cut and form a model for a fast-sailing boat. When a school of these are under sail together they are frequently mistaken for a fleet of native boats."

The fish referred to is in all likelihood *Histiophorus gladius*, a species very closely related to, if not identical, with our own.

E.—SIZE AND RATE OF GROWTH.

27.—MAXIMUM AND AVERAGE SIZE OF AMERICAN SWORD-FISH.

The only individual of which we have the exact measurements was taken off Seaconnet, R. I., July 23, 1874. This was 7 feet and 7 inches long, weighing 113 pounds. Another, taken off Noman's Land, July 20, 1875, and cast in plaster for the collection of the National Museum, weighed 120 pounds, and measured about 7 feet. Another,

taken off Portland, August, 15, 1878, was 3,999 millimeters long, and weighed about 600 pounds. Many of these fish doubtless attain the weight of 400 and 500 pounds, and some, perhaps, grow to 600; but after this limit is reached, I am inclined to believe larger fish are exceptional. Newspapers are fond of recording the occurrence of giant fish, weighing 1,500 pounds and upwards, and old sailors will in good faith describe the enormous fish which they saw at sea, but could not capture; but one well-authenticated instance of accurate weighing is much more valuable. The largest one ever taken by Capt. Benjamin Ashby, for twenty years a swordfisherman, was killed on the shoals back of Edgartown, Mass. When salted it weighed 639 pounds. Its live weight must have been as much as 750 or 800 pounds. Its sword measured nearly 6 feet. This was an extraordinary fish among the three hundred or more taken by Captain Ashby in his long experience. He considers the average size to be about 250 pounds dressed, or 325 alive. Captain Martin, of Gloucester, estimates the average size at 300 to 400 pounds. The largest known to Captain Michaux weighed 625 pounds. The average about Block Island he considers to be 200 pounds.

There are other stories of large fish. Capt. R. H. Hurlbert, of Gloucester, killed one on George's Banks, in September, 1876, which weighed when dressed 480 pounds. Capt. John Rowe, of the same port, salted one which filled two and one-half barrels. This probably weighed 600 pounds when alive. I have been told that a Sword-fish loses one-third of its weight in dressing, but I should think that one-fourth would be nearer to the truth. Captain Baker, of the schooner "Peter D. Smith", of Gloucester, assures me that he killed, in the summer of 1874, off Portland, a Sword-fish which weighed 750 pounds.

Mitchill and DeKay state that in 1791 a Sword-fish 16 feet in length was exhibited in New York. It is questionable whether they often exceed this measurement. My own observations have been made on specimens from 7 to 12 feet long. A stuffed specimen in the United States National Museum measures eleven feet, and this seems to be very nearly the average size.

28.—MINIMUM SIZE OF AMERICAN SWORD-FISH.

The size of the smallest Sword-fishes taken on our coast is a subject of much deeper interest, for it throws light on the time and place of breeding. There is some difference of testimony regarding the average size, but all fishermen with whom I have talked agree that very small ones do not find their way into our waters. I have collected several instances from the experiences of men long wonted to this fishery.

Capt. John Rowe has seen one which did not weigh more than 75 pounds when taken out of the water.

Capt. R. H. Hurlbert killed, near Block Island, in July, 1877, one which weighed 50 pounds, and measured about 2 feet without its sword.

Captain Ashby's smallest weighed about 25 pounds when dressed;

this he killed off Noman's Land. He never killed another which weighed less than 100. He tells me that a Bridgeport smack had one weighing 16 pounds (or probably 24 when alive), and measuring 18 inches without its sword.

In August, 1878, a small specimen of the mackerel shark, *Lamna cornubica*, was captured at the mouth of Gloucester Harbor. In its nostril Dr. Bean found the sword, between 1 and 2 inches long, of a young Sword-fish. When this was pulled out the blood flowed freely, indicating that the wound was recent. The fish to which this sword belonged cannot have exceeded 10 or 12 inches in length. Whether the small Sword-fish met with its misfortune in our waters, or whether the shark brought this trophy from beyond the sea, is a question I cannot answer.

Lütken speaks of a very young individual taken in the Atlantic, lat. 32° 50' N., long. 74° 19' W. This must be about 150 miles southeast of Cape Hatteras.

29.—SIZE OF SWORD-FISH IN THE MEDITERRANEAN.

In the Mediterranean, near Sicily and Genoa, young fish, ranging in weight from half a pound to 12 pounds, are said to be abundant between November and March.

About La Ciotat and Martigues, in the south of France, many are taken too small to injure the fishing-nets, and very rarely reaching the weight of 100 pounds.

From the statements of Bloch and later writers it appears that large Sword-fish also are abundant in the Mediterranean. Late Italian fishery reports state that the average weight of those taken on the coast of Italy is 50 kilograms (110 pounds).

Of the coasts of Spain and Portugal Steindachner remarks: "More abundant on the southern coasts of Spain than on the northern, western, and eastern sides of the Iberian peninsula. We saw quite large examples in the fish-markets at Gibraltar, Cadiz, Lisbon, La Coruña, and Barcelona, and at Santa Cruz, Teneriffe. The largest of three specimens in my possession is 43 inches long, another 24 inches."*

30.—RATE OF GROWTH.

Little is known about the rate of growth. The young fish taken in winter in the Mediterranean, ranging in weight from half a pound to 12 pounds, are thought to have been hatched during the previous summer. Those of a larger size, ranging from 24 to 60 pounds, taken on the New England coast in the summer, may perhaps be the young of the previous year. Beyond this even conjecture is fruitless. As in other species, the rate of growth depends directly upon the quantity of food consumed. It is to be presumed that a summer passed in feasting among the crowding schools of menhaden and mackerel in our waters

would bring about a considerable increase in weight. That this is the case is clearly shown by the testimony of the fishermen, who say that in the spring Sword-fish are thin, growing fatter and heavier as the season goes on.

Dr. Lütken and Dr. Günther have lately made some exceedingly interesting observations upon the young of the Sword-fish and of the Spear-fish and Sail-fish. A translation of Dr. Lütken's paper, furnished by Dr. T. H. Bean, is given in the Appendix (paragraph 64).

Dr. Günther's studies were made upon very small specimens of undetermined species, belonging to either *Tetrapturus*, *Histiophorus*, or both. In his latest work, "The Study of Fishes," he summarizes the facts observed by him as follows:

"The Sword-fishes with ventral fins (*Histiophorus*) belong to the Teleosteans of the largest size. In young individuals, 9 millimeters long, both jaws are produced and armed with pointed teeth, the supraorbital margin is ciliated, the parietal and preoperculum are prolonged into long spines, the dorsal and anal fins are a long fringe, and the ventrals make their appearance as a pair of short buds. When 14 millimeters long the young fish has still the same armature of the head, but the dorsal fin has become much higher, and the ventral filaments have grown to a great length. At the next stage, when the fish has attained to a length of 60 millimeters, the upper jaw is considerably prolonged beyond the lower, losing its teeth, the spines of the head are shortened, and the fins assume nearly the shape which they retain in mature individuals.

"Young Sword-fishes without ventral fins (*Xiphias*) undergo similar changes, and, besides, their skin is covered with small, rough excrescences, longitudinally arrayed, which continue to be visible after the young fish has attained the form of the mature in other respects."

Dr. Lütken's description of the young Sword-fishes is an exceedingly valuable contribution to knowledge.

I have collected together, in the plates which accompany this paper, the various published figures of young Sword-fishes, and have had them redrawn as nearly as possible to a uniform scale.

Of the Sword-fish, *Xiphias gladius*, two figures are given. One, taken from Lütken's "Spolia Atlantica" (pl. ii, fig. 10), is 37 millimeters long; the other is a reproduction of the often-copied figure in Cuvier and Valenciennes's "Histoire Naturelle des Poissons" (pl. ccxxv), 12 to 18 inches long. Lütken had a smaller specimen, 10 millimeters long, but it was too poorly preserved to be figured.

Of the various species of *Tetrapturus* and *Histiophorus*, six figures are given. The smallest is that from "Spolia Atlantica" (pl. ii, fig. 11), and is of a fish $5\frac{1}{2}$ millimeters long. Lütken remarks that he has a series from $5\frac{1}{2}$ to 12 millimeters long which differ very little from each other. The next in size is copied from Günther, and is probably about 10 millimeters long; the third, also from Günther, is 14 millimeters long. Lütken has another link in the series, a specimen 21 millimeters long, which

he has not figured. The fourth stage is from Günther, a specimen 60 millimeters long; the fifth, from Cuvier and Valenciennes (pl. ccxxx), their *Histiophorus pulchellus*, about 410 millimeters long; the sixth, from Rüppell, a copy of his figure of *H. immaculatus*, said to be about 1,800 millimeters long. These illustrations show the development in a very satisfactory manner.

F.—ABUNDANCE.

31.—ABUNDANCE AT THE PRESENT TIME.

For many years from 3,000 to 6,000 of these fish have been taken annually on the New England coast. It is not unusual for twenty-five or more to be seen in the course of a single day's cruising, and sometimes as many as this are visible from the mast-head at one time. Captain Ashby saw twenty at one time, in August, 1839, between George's Banks and the South Shoals. One Gloucester schooner, the "Midnight", Capt. Alfred Wixon, took fourteen in one day on George's Banks, in 1877.

Capt. John Rowe obtained twenty barrels, or 4,000 pounds, of salt fish on one trip to George's Banks; this amount represents twenty fish or more.

Captain Ashby has killed 108 Sword-fish in one year; Capt. M. C. Tripp killed about 90 in 1874.

Such instances as these indicate in a general way the abundance of the Sword-fish. A vessel cruising within 50 miles of our coast, between Cape May and Cape Sable, and during the months of June, July, August, and September, cannot fail, on a favorable day, to come in sight of several of them. Mr. Earll writes that the fishermen of Portland never knew them more abundant than in 1879. This is probably, in part, due to the fact that the fishery there is of very recent origin.

32.—ABUNDANCE IN THE PAST AND PROBABILITY OF FUTURE DECREASE.

There is no evidence of any change in their abundance, either increase or decrease. Fishermen agree that they are as plenty as ever, nor can any change be anticipated. The present mode of fishing does not destroy them in any considerable numbers, each individual fish being the object of special pursuit. The solitary habits of the species will always protect them from wholesale capture, so destructive to schooling fish. Even if this were not the case, the evidence proves that spawning Sword-fish do not frequent our waters. When a female shad is killed thousands of possible young die also. The Sword-fish taken by our fishermen carry no such precious burden.

33.—EFFECTS OF OVERFISHING IN THE MEDITERRANEAN.

A very different tale was once told of the winter fishery in the Mediterranean. Meunier quotes this testimony by Spallanzani: "I took part

many times in this fishery, and I dare not tell how many young fish are its victims; being of no value they are thrown back into the sea, mutilated or already dead from the rubbing of the net-meshes. I write denouncing this destructive method, and I urge forcibly the harm which results from it. They tell me it is true that there is a law of Genoa which forbids its use, or rather its abuse, but this does not do away with the fact that each year there sail from the Gulf of Spezzia three or four pairs of fishing boats which go to the sea to carry on this fishery. Still more, the governor of the place, who should carry out this law, is the first to favor, by means of a gift of silver, the abuse which it is intended to prevent."

This, however, was a century ago. I have met with no complaints of decrease in the works of later writers, though in Targioni Tozzetti's report, published in 1880, it is stated that there is much opposition to the capture of small fish.

G.—FOOD.

34.—NATURE OF FOOD.

Dr. Fleming found the remains of *Sepia* in its stomach, and also small fishes. Oppian says that it eagerly devours the *Hippuris* (probably *Coryphæna*).

A specimen taken off Seaconnet, July 22, 1875, had in its stomach the remains of small fish, perhaps *Poronotus*, and jaws of a squid, perhaps *Loligo Pealii*.

Their food in the Western Atlantic consists for the most part of the common schooling species of fishes.

35.—MANNER OF OBTAINING FOOD.

They feed on menhaden, mackerel, bonitoes, bluefish, and other species which swim in close schools. Their habits of feeding have often been described to me by old fishermen. They are said to rise beneath the school of small fish, striking to the right and left with their swords until they have killed a number, which they then proceed to devour. Menhaden have been seen floating at the surface which have been cut nearly in twain by a blow of the sword. Mr. John H. Thomson remarks that he has seen them apparently throw the fish in the air, catching them on the fall.

Capt. Benjamin Ashby says that they feed on mackerel, herring, whiting, and menhaden. He has found half a bucket full of small fish of these kinds in the stomach of one Sword-fish. He has seen them in the act of feeding. They rise perpendicularly out of the water until the sword and two-thirds of the remainder of the body are exposed to view. He has seen a school of herring crowding together at the surface on George's Banks as closely as they could be packed. A Sword-fish came up through the dense mass and fell flat over on its side,

striking many fish with the sides of its sword. He has at one time picked up as much as a bushel of herrings thus killed by a Sword-fish on George's Banks.

H.—REPRODUCTION.

36.—LOCATION OF THE BREEDING GROUNDS.

But little is known regarding their time and place of breeding. They are said to deposit their eggs in large quantities on the coasts of Sicily, and European writers give their spawning time as occurring the latter part of spring and the beginning of summer. In the Mediterranean they occur of all sizes from 400 pounds down, and the young are so plentiful as to be a common article of food. Except in this region the young are never taken; on our own coast, plentiful as they are, they are never seen less than 3 feet, and are usually much larger. M. Raynaud, who brought to Cuvier a specimen of *Histiophorus* four inches long, taken in January, 1829, in the Atlantic, between the Cape of Good Hope and France, reported that there were great numbers of young Sail-fish in the place where this was taken.

Old fishermen who have taken and dressed them by the hundreds assure me that they have never seen traces of spawn in them. The absence of young fish and spawning females on the coast of North America would indicate that they do not breed with us. Judging from the locations where young fish have been taken, it seems probably that they breed in the open ocean. (See paragraph 16, and the paper by Dr. Lütken in the Appendix, paragraph 64.)

37.—HABITS OF THE SWORD-FISH IN THE BREEDING SEASON.

Meunier,† quoting Spallanzani, states that the Sword-fish does not approach the coast of Sicily except in the season of reproduction; the males, are then seen pursuing the females. It is a good time to capture them, for when the female has been taken the male lingers near and is easily approached. The fish are abundant in the Straits of Messina from the middle of April to the middle of September; early in the season they hug the Calabrian shore, approaching from the north; after the end of June they are most abundant on the Sicilian shore, approaching from the south.

From other circumstances, it seems certain that there are spawning grounds in the sea near Sicily and Genoa, for from November to the 1st of March young ones are taken in the Straits of Messina, ranging in weight from half a pound to twelve pounds.

* Cuv. & Val. Hist. Nat. Poiss. viii, p. 305.

† Les Grandes Pêches, p. 142.

38.—ABSENCE OF ORDINARY HABITS OF BREEDING SEASON AMONG OUR SWORD-FISH.

In the Mediterranean, as has been already stated, the very young fish are found from November to March, and here from July to the middle of September the male fish are seen pursuing the female over the shoals, and at this time the males are easily taken. Old swordfishermen assure me that on our coast, out of thousands of specimens they have taken, they have never seen one containing eggs (Captain Ashby and Captain Kirby). I have myself dissected several males, none of which were near breeding time. In the European waters they are said often to be seen swimming in pairs, male and female. Many sentimental stories were current, especially among the older writers, concerning the conjugal affection and unselfish devotion of the Sword-fish, but these seem to have originated in the imaginative brain of the naturalist rather than in his perceptive faculties. It is said that when the female fish is taken the male seems devoid of fear, approaches the boat, and allows himself easily to be taken; but if this be true, this appears to be the case only in the height of the breeding season, and is easily understood. I cannot learn that two Sword-fish have ever been seen associated together in our waters, though I have made frequent and diligent inquiry.

There is no inherent improbability, however, in this story regarding the Sword-fish in Europe, for the same thing is stated by Professor Poey as the result of his studies upon the habits of *Tetrapturus*.

39.—CURIOUS ANCIENT BELIEFS CONCERNING THE VIVIPAROUS REPRODUCTION OF THE SWORD-FISH.

A curious fancy was prevalent in former days regarding an anatomical character of the Sword-fish. In an article by Mr. Dale in Philosophical Transactions (abridged edition, ii, p. 835), he remarks: "I cannot conceive it to be consonant to that Care and Industry of Nature, in providing convenient Receptacles for preserving the *Fœtus*; neither is it agreeable to Reason to believe, that when Nature hath provided an Uterus in all Animals, not only the Viviparous, and such as only cherish the Embryo in Utero, but in the Oviparous also and Insects, the *Eel* and the *Xiphia*, or Sword-fish, should be the only Animals without it."

I.—ENEMIES AND FATALITIES.

40.—PUGNACITY.

The pugnacity of the Sword-fish has become a by-word. Without any special effort on my part, the following instances of their attacks upon vessels have, in the last six years, found their way into the pigeon-hole labeled "A, III, 76, Sword-fish"

Aelian says (B. xxxii, C. 6) that the Sword-fish has a sharp-pointed snout with which it is able to pierce the sides of a ship and send it to the bottom; instances of which have been known near a place in Mauritania known as Cottè, not far from the river Lixus, on the African side of the Mediterranean. He describes the sword as like the beak of the ship known as the trireme, which was rowed with three banks of oars.

One of the earliest accounts is that given in the second part of vol. i, lib. ii, p. 89, 1615, of Purchas' Pilgrims:

"The sixth Circum-Navigation, by William Cornelison Schovten of Horne; who Southwards from the Straights of Magelan in Tierra-Del-fvogo, fovnd and discovered a new passage through the great South-Sea, and that way sailed rovnd about the World," &c.

Off the coast of Sierra Leone:

"The fift of October we were vnder foure degrees seven and twentie minutes, the same day about noone, there was such a noyse in the Bough of our Shippe, that the master, being behind in the Gallerie, thought that one of the men had fallen out of the Fore-ship, or from the Boe-sprit into the sea, but as hee looked out over the side of the Ship hee saw the Sea all red, as if great store of bloud had beene powred into it, whereat hee wondred, knowing not what it meant, but afterward hee found, that a great Fish or a Sea monster having a horne had therewith stricken against the ship with most great strength. For when we were in Porto Desire where we set the Ship on the Strand to make it cleane, about seven foot under water, before in the Ship, wee found a Horne sticking in the Ship, much like for thicnesse and fashion to a common Elephants tooth, not hollow, but full, very strong hard Bone, which had entered into three Plankes of the Ship, that is two thicke Plankes of greene and one of Oken wood, and so into a Rib, where it turned upward, to our great good fortune, for if it had entered between the Ribbes, it would happily have made a greater Hole and have brought both Ship and men in danger to be lost. It strucke at least halfe a foote deepe into the Ship and about half a foote without, where, with great force it was broken off, by reason whereof the great monster bled so much."

More than a century later C. Mortimer, M. D., records this experience:

"Mr. Bankley shewed me the *Horn* of a *Fish* that had penetrated above 8 inches into the Timber of a Ship and gave me the following Relation of it: 'His MAJESTY'S Ship *Leopard*, having been at the *West Indies* and on the Coast of *Guiney*, was ordered by Warrant from the Honorable *Navy-Board*, dated Aug. 18, 1725, to be cleaned and refitted at *Portsmout* for *Channel-Service*: Pursuant thereto, she was put into the great *Stone-dock*; and, in stripping off her *Sheathing*, the *Shipwrights* found something that was uncommon in her *Bottom*, about 8

Feet from her Keel, just before the Fore Mast; which they searching into, found the Bone or Part of the Horn of a Fish of the Figure here described; the Outside Rough not unlike *Seal-Skin*; and the End, where it was broken off shewed itself like coarse Ivory. The Fish is supposed to have followed the Ship, when under Sail, because the sharp End of the Horn pointed toward the Bow: It penetrated with that Swiftness or Strength that it went through the Sheathing 1 Inch thick, the Plank 3 Inches thick, and into the Timber $4\frac{1}{2}$ Inches.”*

Don Joseph Cornide, in his “*Essayo de Una Historia de los Peces de la Costa de Galicia*”, 1787:

“This fish is taken in the seas of Galicia, where it is more common toward the Rio de Vigo, where it is well known that the *Balandia* (a small fishing vessel) of S. M. le *Ardilla* was pierced in its side and sunk by the arm of one of these fishes, which is preserved in the Royal Cabinet of Natural History.”

In 1871 the little yacht “*Redhot*”, of New Bedford, was out swordfishing, and a Sword-fish had been hauled in to be lanced, and it attacked the vessel and pierced the side so as to sink the vessel. She was repaired and used in the service of the Commission at Wood’s Holl. (Professor Baird.)

Couch quotes the personal statement of a gentleman, who says:

“We have had the pleasure of inspecting a piece of wood cut out of one of the fore planks of a vessel (the ‘*Priscilla*’, from Pernambuco), through which was struck about 18 inches of the bony weapon of the Sword-fish. The force with which it must have been driven in affords a striking exemplification of the power and ferocity of the fish. The ‘*Priscilla*’ is quite a new vessel. Captain Taylor, her commander, states that when near the Azores, as he was walking the quarter-deck at night, a shock was felt which brought all hands from below, under the impression that the ship had touched upon some rock. This was, no doubt, when the occurrence took place.”

The New York Herald of May 11, 1871, states:

“The English ship ‘*Queensberry*’ has been struck by a Sword-fish, which penetrated to a depth of 30 inches, causing a leak which necessitated the discharge of the cargo.”

The London Daily News of December 11, 1868, contained the following paragraph, which emanated, I suspect, from the pen of Prof. R. A. Proctor:

“Last Wednesday the court of common pleas—rather a strange place, by the by, for inquiring into the natural history of fishes—was engaged for several hours in trying to determine under what circumstances a Sword-fish might be able to escape scot-free after thrusting his snout into the side of a ship. The gallant ship ‘*Dreadnought*’, thoroughly repaired, and classed A1 at Lloyd’s, had been insured for £3,000

*An Account of the horn of a Fish struck several Inches into the side of a Ship, by C. Mortimer, M. D. F. R. S. . Philos. Trans. xl, No. 461, p. 862, 1741. Abr. ed. ix, p. 72.

against all the risks of the seas. She sailed on March 10th, 1864, from Colombo, for London. Three days later the crew, while fishing, hooked a sword-fish. Xiphias, however, broke the line, and a few moments after leaped half out of the water, with the object, it should seem, of taking a look at his persecutor, the 'Dreadnought'. Probably he satisfied himself that the enemy was some abnormally large cetacean, which it was his natural duty to attack forthwith. Be this as it may, the attack was made, and at four o'clock the next morning the captain was awakened with the unwelcome intelligence that the ship had sprung a leak. She was taken back to Colombo, and thence to Cochin, where she was hove down. Near the keel was found a round hole, an inch in diameter, running completely through the copper sheathing and planking.

"As attacks by Sword-fish are included among sea risks, the insurance company was willing to pay the damages claimed by the owners of the ship if only it could be proved that the hole had really been made by a Sword-fish. No instance had ever been recorded in which a Sword-fish had been able to withdraw his sword after attacking a ship. A defense was founded on the possibility that the hole had been made in some other way. Professor Owen and Mr. Frank Buckland gave their evidence, but neither of them could state quite positively whether a Sword-fish which had passed its beak through three inches of stout planking could withdraw without the loss of its sword. Mr. Buckland said that fish have no power of 'backing,' and expressed his belief that he could hold a Sword-fish by the beak; but then he admitted that the fish had considerable lateral power, and might so 'wriggle its sword out of a hole'. And so the insurance company will have to pay nearly six hundred pounds because an ill-tempered fish objected to be hooked, and took its revenge by running full tilt against copper sheathing and oak planking."

The Gloucester schooner "Wyoming", on a last trip to George's Banks, records the *New York World* of August 31, 1875, was attacked by a Sword-fish in the night time. He assailed the vessel with great force, and succeeded in putting his sword through one of her planks some two feet, and after making fearful struggles to extricate himself, broke his sword off, leaving it hard and fast in the plank, and made a speedy departure. Fortunate was it that he did not succeed in drawing out his sword, as the aperture would undoubtedly have made a leak sufficient to have sunk the vessel. As it was, she leaked badly, requiring pretty lively pumping to keep her free.*

Another instance of a similar nature is this, which was recorded in the *Liverpool Mercury* about the year 1876:

"Mr. J. J. Harwood, master of the British brigantine 'Fortunate', in dock at Liverpool, reports that whilst on his passage from the Rio Grande, when in latitude 20° 12' north and longitude 47° 9' west, this

**New York World*, August 31, 1875.

ship was struck by a large fish, which made the vessel shake very much. Thinking the ship had been merely struck by the tail of some sea-monster, he took no further notice of the matter; but, after discharging cargo at Runcorn; and coming into the Canada half-tide dock, he found one of the plank ends in the stern split, and on closer examination he discovered that a Sword-fish had driven his sword completely through the plank, four inches in thickness, leaving the point of the sword nearly eight inches through the plank. The fish in its struggle broke the sword off level with the outside of the vessel, and by its attack upon the ship lost nearly a foot length of the very dangerous weapon with which it was armed. There is no doubt that this somewhat singular occurrence took place when the vessel was struck as Captain Harwood describes."

Forest and Stream of June 24, 1875, recorded the following incident:

"On Wednesday of last week a Sword-fish attacked the fishing-boat of Capt. D. D. Thurlow while he was hauling mackerel-nets off Fire Island, thrust its sword clear through the bottom, and stuck fast, while the fishermen took several half-hitches around its body and so secured it. It was afterwards brought to Fulton Market, and found to weigh 390 pounds. Its sword measured 3 feet and 7 inches, and its entire length was over 11 feet. The stuffed skin will adorn the Central Park Museum."

The Landmark, of Norfolk, Va., also mentioned a similar occurrence in February, 1876:

"The brig 'P. M. Tinker', Captain Bernard, previously mentioned as having arrived here from Richmond, leaking, for repairs, has been hauled up on the ways at Graves's ship-yard. On examination it was discovered that the leak was caused by a Sword-fish, the sword being found broken off forward the bands, about sixteen feet abaft the forefoot. The fish, in striking the vessel, must have come with great force, as the sword penetrated the copper sheathing, a four-inch birch plank, and through the timbers about six inches—in all about ten inches. It occurred on the morning of the 23d of December, when the brig was eight-teen days out from Rio, and in the neighborhood of Cape St. Roque. She was pumped about 4 o'clock in the morning, and found free of water. About 6 o'clock the same morning she was again pumped, when water was obtained, and on examination it was found that she had made ten inches of water. The men were kept steady at the pumps until her arrival at Richmond, and while there, and on her trip here."

Mr. Willard Nye sends me this note:

"A few years ago Captain Dyer, of New Bedford, struck a Sword-fish, from a thirty-foot boat, forty miles southwest of Noman's Land, threw overboard the keg, tacked, and stood by to the windward of it. When nearly abreast of it the man at the masthead called out, 'Why here he

is, right alongside.' The fish was then about 10 feet from the boat, and swimming in the same direction, but when he got where he could see the splash of water around the bow he turned and struck the boat about 2 feet from the stern and just below the water-line. The sword went through the planking, which was of cedar an inch and three-quarters thick, into a lot of loose iron ballast, breaking off short at the fish's head. A number of boats, large and small, have been 'stove' by Sword-fish on our coast, but always after the fish had been struck."

A nameless writer in Harper's Weekly, October 25, 1879, narrates these instances, for which I am unable to give the original authority:

"In a calm day in the summer of 1832, on the coast of Massachusetts, a pilot was rowing his little skiff leisurely along, when he was suddenly roused from his seat by a thrust from below by a Sword-fish, who drove his sharp instrument more than three feet up through the bottom. With rare presence of mind, with the butt of an oar he broke it off level with the floor before the fish had time to withdraw it. Fortunately, the thrust was not directly upward. Had it been so, the frail boat would have been destroyed.

"A Boston ship hauled up on the ways for repair, a few years since, presented the shank of a Sword-fish's dagger, which had been driven considerably far into the solid oak plank. A more curious affair was brought to light in 1725 in overhauling His Majesty's ship 'Leopard', from the coast of Africa. The sword of this marine spearsman had pierced the sheathing one inch, next it went through a three-inch plank, and beyond that three inches and a half into the firm timber. It was the opinion of the mechanics that it would have required nine strokes of a hammer weighing twenty-five pounds to drive an iron bolt of the same dimensions to the same depth in the hull. Yet the fish drove it at a single thrust.

"On the return of the whale-ship 'Fortune' to Plymouth, Mass., in 1827, the stump of a sword-blade of this fish was noticed projecting like a cog outside, which, on being traced, had been driven through the copper sheathing, an inch-board undersheathing, a three-inch plank of hard wood, the solid white-oak timber twelve inches thick, then through another two-and-a-half-inch hard-oak ceiling, and lastly penetrated the head of an oil-cask, where it stuck, not a drop of the oil having escaped."

Such instances could be found by the score, if one had the time and patience to search. The thing happens many times a year, and nearly as often affords a text for some paragrapher or local editor.

Captain Beechey, in the narrative of the voyage of H. M. S. "Blossom", mentions the following incident which occurred in the Pacific, near Easter Island: "As the line was hauling in, a large Sword-fish bit at the tin case which contained our thermometer, but fortunately failed in carrying it off."

41.—PUGNACITY OF THE SPEAR-FISH.

The Spear-fish (*Tetrapturus albidus*, &c.) also strikes vessels. I am indebted to Capt. William Spicer, of Noank, Conn., for this note:

Mr. William Taylor, of Mystic, a man seventy-six years old, who was in the smack 'Evergreen', Capt. John Appleman, states that he started from Mystic, October 3, 1832, on a fishing voyage to Key West, in company with the smack 'Morning Star,' Captain Rowland. On the 12th they were off Cape Hatteras, the wind blowing heavily from the north-east, and the smack under double-reefed sails. At ten o'clock in the evening they were struck by a 'Woho' (*sic*), which shocked the vessel all over. The smack was leaking badly, and they made a signal to the 'Morning Star' to keep close by them. The next morning they found the leak, and both smacks kept off to Charleston. On arrival they took out the ballast, hove her out, and found that the sword had gone through the planking, timber, and ceiling. The plank was 2 inches thick, the timber 5 inches, and the ceiling 1½ inches white oak. The sword projected 2 inches through the ceiling, on the inside of the "after-run".* It struck close by a butt on the outside, which caused the leak. They took out and replaced a piece of the plank, and proceeded on their voyage."

J. Matthew Jones, esq., of Halifax, N. S., in his delightful little book "The Naturalist in Bermuda", records the case of the Bermudian schooner "Earl Dundonald", arrived in the port of Hamilton, which was pierced by one of these formidable fish off the coast of British Guiana.

In the museum of Charleston College, Charleston, S. C., is preserved a fragment of the snout of a Bayonet-fish, apparently *Tetrapturus albidus*. By the kindness of the curator, Dr. G. E. Manigault, I was allowed to examine it and copy the label, which reads as follows: "The brig 'Amsterdam', bound to Charleston, owned by F. O. Bray, was struck in the Gulf Stream by a monster or Sword-fish, which caused the vessel to leak considerably. By great exertion she was kept free, and gained the port in safety."

Messrs. Foster, Waterman & Co., of Boston, presented to the Boston Society of Natural History, in 1869, a plank of Southern pine perforated by and containing a portion of the sword of a Sword-fish (*Histiophorus*) from the side of the ship "Pocahontas", owned by them. (Proc. Bost. Soc. Nat. Hist. xiii, 1869, p. 64.)

42.—ATTACKS OF THE SWORD-FISH UPON WHALES.

One of the traditions of the sea, time-honored, believed by all mariners, handed down in varied phases in a hundred books of ocean travel, relates to the terrific combats between the whale and the Sword-fish, aided by the thrasher-shark. The Sword-fish was said to attack from

*A hold under the cabin.

below, goading his mighty adversary to the surface with his sharp beak, while the thrasher, at the top of the water, belabored him with strokes of his long, lithe tail.

An early explorer of the Bermudas gives the following version of the story, with tone so fresh and enthusiastic that we might well believe him to have seen the occurrence with his own eyes. The passage occurs in "Newes from the Bermudas", a pamphlet dated "Burmuda, July, 1609", and reprinted in "Force's Historical Tracts", vol. ii:

"*Whale, Sword-fish & Threasher.*—The sword-fish swimmes under the whale, & pricketh him upward. The threasher keepeth above him, & with a mighty great thing like unto a flaile, hee so bangeth the whale, that hee will roare as though it thundered, & doth give him such blowes, with his weapon, that you would thinke it to be a crake of great shot."—(Page 22.)*

Skeptical modern science is not satisfied with this interpretation of any combat at sea seen at a distance. It recognizes the improbability of aggressive partnership between two animals so different as the Sword-fish and a shark, and explains the turbulent encounters occasionally seen at sea by ascribing them to the attacks of the killer-whale, *Orca* sp., upon larger species of the same order.

There can be little doubt though that Sword-fish sometimes attack

* The following is a fair example of the average newspaper paragrapher's treatment of the subject:

"*Combats of the ocean.*—Among the extraordinary spectacles sometimes witnessed by those who "go down to the sea in ships" none are more impressive than a combat for the supremacy between the monsters of the deep. The battles of the Sword-fish and whale are described as Homeric in grandeur. The Sword-fish go in schools like whales, and the attacks are regular sea-fights. When the two troops meet, as soon as the Sword-fish have betrayed their presence by a few bounds in the air, the whales draw together and close up their ranks. The Sword-fish always endeavors to take the whale in the flank, either because its cruel instinct has revealed to it the defect in the carcasses—for there exists near the brachial fins of the whale a spot where wounds are mortal—or because the flank presents a wider surface to its blow. The Sword-fish recoils to secure a greater impetus. If the movement escapes the keen eye of his adversary the whale is lost, for it receives the blow of the enemy and dies instantly. But if the whale perceives the Sword-fish at the instant of the rush, by a spontaneous bound it springs clear of the water its entire length, and falls on its flank with a crash that resounds for many leagues, and whitens the sea with boiling foam. The gigantic animal has only its tail for its defense. It tries to strike its enemy, and finishes him at a single blow. But if the active Sword-fish avoids the fatal tail the battle becomes more terrible. The aggressor springs from the water in his turn, falls upon the whale, and attempts, not to pierce, but to saw it with the teeth and garnish its weapon. The sea is stained with blood; the fury of the whale is boundless. The Sword-fish harrasses him, strikes him on every side, kills him, and flies to other victories. Often the Sword-fish has not time to avoid the fall of the whale, and contents itself with presenting its sharp saw to the flank of the gigantic animal about to crush it. It then dies like Maccaneus (*sic*), smothered beneath the weight of the elephant of the ocean. Finally, the whale gives a last few bounds in the air, dragging its assassin in its flight, and perishes as it kills the monster of which it was the victim."

whales just as they do ships. The habit is mentioned by Pliny, and is the motive for one of the *Visions of the World* of Edmund Spenser:

Toward the sea turning my troubled eye
 I saw the fish, (if fish I may it cleepe)
 That makes the sea before his face to flye
 And with his flaggie finnes doth seeme to sweepe
 The fomie waves out of the dreadfull deep.
 The huge Leviathan, dame Nature's wonder,
 Making his sport, that manie makes to weep:
 A Sword-fish small, him from the rest did sunder,
 That, in his throat him pricking softly under,
 His wide abyasse him forced forth to spewe,
 That all the sea did roare like heavens thunder,
 And all the waves wore stained with filthie hewe.
 Hereby I learned have not to despise
 Whatever thing seems small in common eyes.*

I give also a few lines from an old play quoted by Scott as a heading to one of the chapters of the "The Antiquary":

Who is he †—One that for the lack of land
 Shall fight upon the water—he hath challenged
 Formerly the grand whale; and by his titles
 Of Leviathan, Behemoth, and so forth
 He tilted with a Sword-fish.—Marry, sir,
 Th' aquatic had the best—the argument
 Still galls our champion's breach. †

Baron Lahontan, in a letter from Quebec, November 8, 1783, described an engagement between a whale and a Sword-fish which took place within gun-shot of his frigate. He remarks:

"We were perfectly charmed when we saw the Sword-fish jump out of the water in order to dart its spear into the body of the whale when obliged to take breath. This entertaining show lasted at least two hours, sometimes to the starboard and sometimes to the larboard of the ship. The sailors, among whom superstition prevails as much as among the Egyptians, took this for a presage of some mighty storm."‡

Another early observer wrote as follows:

"Concerning the Death of the Whale, which hath been related to have been stranded upon *New England*, it is not very improbable but that it may have been killed by a certain *Horny Fish*, which is said by Mr. Terry, in his *East India Voyage*, to run his Horn into the *Whale's Belly*; and which is known sometimes to run his Horn into Ships, perhaps taking them for Whales, and there snapping it asunder, as happened not long since to an English Vessel in the West Indian Seas."§

* Spenser's *Visions of the Worlds Vanitie*, 1591.

† "Old Play," *Antiquary*, chap. xxx.

‡ *Travels in Canada*, 2d ed., London, 1785, 2 vols. 8vo.

§ An account of Whale fishing about the Bermudas by an understanding and hardy Seaman. *Phil. Trans. abr. ed. ii*, p. 844.

"In the month of August, 1861," says Couch, "near Westra, one of the northernmost islands of the Orkneys, an individual of the smaller species of whales, known as the herring-hog, was attacked by a Sword-fish; and when thus compelled to leap out of the water, which it did to the height of six feet, it was observed that the sword had been thrust into the whale's body behind the pectoral fins. Its leaps continued, and then it was perceived that a thrasher was assailing it on the sides."*

Captain Crow, quoted by Parnell, relates the following incident as having occurred on a voyage to Memel: "One morning, during a calm, when near the Hebrides, all hands were called up at 3 a. m. to witness a battle between several of the fish called thrashers or fox-sharks and some Sword-fish on one side, and an enormous whale on the other. It was the middle of summer, and the weather being clear and the fish close to the vessel, we had a fine opportunity of witnessing the contest. As soon as the whale's back appeared above the water, the thrashers, springing several yards into the air, descended with great violence upon the object of their rancor, and inflicted upon him the most severe slaps with their long tails, the sound of which resembled the reports of muskets fired at a distance. The Sword-fish, in their turn, attacked the distressed whale, stabbing from below, and thus beset on all sides and wounded, when the poor creature appeared the water around him was dyed with blood. In this manner they continued tormenting him and wounding him for many hours, and I have no doubt they in the end completed his destruction.†

The following is a story given to Frank Buckland by Mr. Hill, captain of an English trawling vessel:

"The thrasher-sharks just do serve out the whales. The sea sometimes is all blood. A whale once got under our vessel—the 'Hurricane'—to get away from these thrashers, and when she was there we were afraid to throw a rope overboard, almost to walk out, for fear she would chuck her tail, and punch a hole in our vessel. She was full length in water, as clear as gin, right under our bottom, and laid as quiet as a lamb for an hour and a-half, and never moved a fin. Where they had been a-thrashing of her the sea was just like blood. I have seen these 'ere thrashers fly out of the water as high as the mast-head and down upon the whale, while the Sword-fish was a-pricking of 'im up from underneath. There is always two of 'em, one up and one under, and I think they hunts together; and you can see the poor whale blow up in great agitation; and I be bound the pair on 'em don't leave him until they have their penn'orth out of him. It is just for wengeance they does it. Whether Master Whale has offended them or not, it's hard to tell. If they eats him they must have a tidy blow-out of him, but I don't think they like the oil. I saw one engagement off the Staples; it

* History of British Fishes, ii, p. 174.

† Parnell, Fishes of the Firth of Forth, 1838, p. 216.

was all two or three hours they was at it. I don't think they leaves him till they kills him."

Egede puts on record the belief of Danish explorers of the last century :

"The *Sword-fish* who is the Whales greatest Enemy; and when he kills one eats nothing but his Tongue, leaving the rest to the Shark, Walrus and Birds of Prey."*

The last quotation is especially important, since it shows how the *Sword-fish* and the killer-whale have been confused. It is still held, on good authority, that the killers eat the tongues of their victims.†

At a meeting of the Boston Society of Natural History in 1864, in reply to a question of Dr. J. B. S. Jackson about the thrasher or swingle-tail shark recently exhibited in Boston, Captain Atwood said that they were abundant at Provincetown, though not so common as the mackerel-shark. He also observed that he placed no confidence whatever in the stories current of attacks on the whales by the thrasher, believing them to be quite harmless and unable to hurt a dolphin. The story very likely arose from some peculiar movements made by the hump-backed whale. *Sword-fish*, he believed, might attack a whale and kill him, from what he had seen of the force of their thrusts into the bottom of vessels, though he has no evidence that they ever do attack them. He was not aware, either, that the thrasher ever uses his tail for offensive purposes.‡

* Hans Egede, *Natural History of Greenland*, 1741, p. 37.

† "Three or four of these voracious animals do not hesitate to grapple with the largest baleen-whales, and it is surprising to see those leviathans of the deep so completely paralyzed by the presence of their natural although diminutive enemies. Frequently the terrified animal—comparatively of enormous size and superior strength—evinces no effort to escape, but lies in a helpless condition, or makes but little resistance to the assaults of its merciless destroyer. The attack of these wolves of the ocean upon their gigantic prey may be likened, in some respects, to a pack of hounds holding the stricken deer at bay. They cluster about the animal's head, some of their number breaching over it, while others seize it by the lips and haul the bleeding monster under water; and when captured, should the mouth be open, they eat out its tongue. We saw an attack made by three killers upon a cow-whale and her calf, in a lagoon on the coast of Lower California, in the spring of 1858. The whale was of the California gray species, and her young was grown to three times the bulk of the largest killers engaged in the contest, which lasted for an hour or more. They made alternate assaults upon the old whale and her offspring, finally killing the latter, which sunk to the bottom, where the water was five fathoms deep. During the struggle the mother became nearly exhausted, having received several deep wounds about the throat and lips. As soon as their prize had settled to the bottom the three orcas descended, bringing up large pieces of flesh in their mouths, which they devoured after coming to the surface. While gorging themselves in this wise, the old whale made her escape, leaving a track of gory water behind. Instances have been known on the northwestern coast where a band of orcas laid siege to whales that had been killed by whalers, and which were being towed to the ship, in so determined a manner that, although they were frequently lanced, cut with boat-spades, they took the dead animals away from their human captors, and hauled them under water out of sight."—(C. M. Scammon, *Marine Mammals*, p. 89.)

‡ *Proc. Bost. Soc. Nat. Hist.* vol. x, 1864-'66, p. 82.

Captain Scammon, in his "Marine Mammals", gives the following confirmation of Captain Atwood's views, speaking of the habits of the hump-back whale of the Pacific:

"In their wanderings they are addicted more than any other roqual to 'breaching', 'bolting', and 'finning'. In the mating season they are noted for their amorous antics. At such times their caressings are of the most amusing and novel character, and these performances have doubtless given rise to the fabulous tales of the Sword-fish and thrasher attacking whales. When lying by the side of each other the *Megapteras* frequently administer alternate blows with their long fins, which love-pats may, on a still day, be heard at a distance of miles. They also rub each other with these same huge and flexible arms, rolling occasionally from side to side, and indulging in other gambols which can easier be imagined than described."

43.—ENEMIES.

Such a large animal as the Sword-fish can have but few antagonists whose attacks would be disastrous. The tunny or horse-mackerel, *Orcynus thynnus*, other Sword-fishes, and sharks are its only peers in size, and of these the sharks are probably its worst foes.

Capt. N. E. Atwood exhibited to the Boston Society of Natural History, December 7, 1864, the lower jaw of a large shark, taken at Provincetown, Mass., in whose stomach nearly the whole of a large Sword-fish was found. Some ten or twelve wounds were noticed in the skin of the shark, giving an idea of the conflict. The shark was doubtless the tiger shark *Galeocerdo tigrina*.

Couch was told by a sailor that he had watched with interest the anxious motions of one as it was followed closely and rapidly in all its turnings by a blue-shark. Twice did it leap above the surface to escape the near approach of its pursuer, but with what success at last the observer had no opportunity of knowing.

Mr. John A. Thomson states that the Bill-fish (probably *Tetrapturus albidus*) is their especial enemy. Bill-fish, six to twelve feet long, appear about the last of the season, and their appearance is a signal that the Sword-fish are about leaving.

44.—INVERTEBRATE PARASITES OF THE SWORD-FISH.

Aristotle thus explains the leaping movements of the fish: "The tunny and the *Xiphia* suffer from the œstrus at the rising of the dog-star, for both these fish at this season have beneath their fins a little worm which is called œstrus, which resembles a scorpion, and is about the size of a spider; they suffer so much from this torment that the *Xiphias* leaps out of the sea as high as the dolphin, and in this manner frequently falls upon ships."

This description of the parasite is somewhat vague; yet it is evident that allusion is made to one of the Lerneans or gill-lice, little crusta-

ceans remotely resembling crabs and lobsters, which attach themselves to the gills and skin of many kinds of fishes, sucking the blood from their veins, and often causing death; dreadful to their victims as was their namesake, the fabled Lernæan Hydra, to the Argives of old, and not to be destroyed by any piscine Hercules and Iolaus.

In one of the early volumes of the Philosophical Transactions is an account by S. Paulo Boccone of "an extraordinary *Sanguisuga* or *Leech*, found sometimes sticking fast in the Fish called *Xiphias* or *Sword-fish*." It is described as "about four Inches long, the Belly of it white, cartilaginous and transparent, without Eyes or Head, but instead of a Head it had a hollow Snout, encompassed with a very hard Membrane; which Snout it thrusts whole into the Body of the Fish, as strongly as an *Augre* is wound into a piece of Wood, and fills it full of Blood into the very Orifice". He names it "*Hirudo* or *Acus cauda utrinque pennata*".

A specimen taken off Seaconnet, July 22, 1875, had fluke-worms in the external coat of the stomach and in the air-bladder.

I am indebted to Mr. Frederick W. True for the following account of the parasites of the Sword-fish :

The Sword-fish is infested by many species of parasites. Some hang on the gills, others fasten themselves to different parts of the alimentary canal—the œsophagus, the stomach, and the intestines—and others, still, bore into the flesh. Several species, as might be expected from the size of the fish, are among the giants of their races. All undoubtedly cause more or less pain to their host, but especially those which attach themselves to the gills, disturbing their action and destroying their substance.

The parasites of the Sword-fish, for convenience, may be classified in two groups, the Worm-like parasites (*Helminthes*) and the Crustacean parasites.

a. *The Worm-like parasites (Helminthes)*.—Seven species of *Helminthes* from the Sword-fish have been described, of which one belongs to the group *Nematoda*, or Round-worms, four to the *Trematoda*, or Flukes, and two to the *Cestoda*, or Tape-worms.

NEMATODA.

1. *ASCARIS INCURVA*, Rudolphi.

Ascaris incurva, RUDOLPHI, Entozoorum Synopsis, 1819, pp. 51, 292.—DUJARDIN, Hist. Nat. des Helminthes, 1845, p. 203.—DIESING, Systema Helminthum, ii, 1851, p. 163.—SCHNEIDER, Monographie der Nematoden, 1866, p. 48, pl. ii, fig. 11.†

* The | Philosophical | Transactions | and | Collections | To the End of the Year MDCC | Abridged | and | Disposed under General Heads | — | Vol. II | — | Containing all the | Physiological Papers | — | By John Lowthorp, M. A. and F. R. S. | — | The Fourth Edition | — | London * * * * * MDCCXXXI, p. 821.)

† This synonymy does not profess to be complete. Reference is given only to the authority in which the original description occurs, to one or two later ones giving an accurate description, and to one in which the species is figured.

This round-worm belongs to the genus which is characterized by the possession of a mouth with three lips. It is found only in the Sword-fish, and may be readily distinguished by its large size. The male is about 55 millimeters in length, the females about 122 millimeters. It makes its home principally in the intestines and stomach of the fish, causing the growth of morbid tubercles. It has been discovered also in the gills and the œsophagus.

TREMATODA.

2. DISTOMA DENDRITICUM, Rudolphi.

Distoma dendriticum, RUDOLPHI, Entozoorum Synopsis, 1819, pp. 93, 364.—

DUJARDIN, Hist. Nat. des Helminthes, 1845, p. 460.

Distomum dendriticum, DIESING, Systema Helminthum, i, 1850, p. 336.

(This species, as far as I am aware, has never been figured).

This fluke is peculiar to the Sword-fish. It is lanceolato-ovate in outline and quite flat. When alive the color of its body is white, with ramifications of black, a character by which it may be distinguished from other species. It varies in length from 3.37 to 6.75 millimeters, and in width from 1 to 2.25 millimeters. It locates itself in the intestines of the Sword-fish, where it is frequently found in large numbers.

3. DISTOMA VENTRICOSA (Pallas) True.

Fasciola ventricosa, PALLAS, Spicilegia Zoologica, fascie. x, 1774, p. 18.

Distoma clavatum, RUDOLPHI, Entoz. Hist. ii, 1809, p. 391.—OWEN, Trans. Zool. Soc. London, i, pp. 381-384, pl. xli, fig. 17.—DUJARDIN, Hist. Nat. des Helminthes, 1845, p. 459.

This species, which is well displayed in the figure, is somewhat cylindrical in form, but has a globular expansion at the posterior extremity. It often reaches a length of two inches, and a specimen five inches long and nearly half an inch in breadth is said to have been taken from the stomach of a fish captured in the Gulf of Venice. Menzies says of it: "In moving, it fastens itself alternately by the ventral aperture and its mouth, raising its slender neck between them into an arched form, like a leech, and in this manner drags its body along with a slow motion. It is of a whitish color, somewhat pellucid, discharging at its mouth a black-colored fluid, which can easily be perceived through its body." It lives in the stomach of the Sword-fish and other fishes.

4. TRISTOMA COCCINEUM, Cuvier.

Tristoma coccineum, CUVIER, Règne Animal, 1st ed. iv, 1817, p. 62, pl. xv, fig. 10.—DUJARDIN, Hist. Nat. des Helminthes, 1845, pp. 322, 323.—BLANCHARD, Recherches sur l'Organization des Vers, Ann. des Sci. Nat. 3d series, viii, 1847, pp. 322-325, pl. x, fig. 2, and pl. xiv, figs. 2-2 c.

Tristomum coccineum, DIESING, Systema Helminthum, i, 1850, p. 429.

The species composing the genus *Tristoma* are characterized by the possession of three suckorial disks.

T. coccineum is almost orbicular in outline and quite flat. The posterior border is never scalloped, as in a closely allied species. The diameter of the posterior sucker is nearly equal to one-fifth the length of the body, and presents seven rays. The total length of the animal is about 25 millimeters. Its color, according to some authors, is rose-red, but, according to others, red approaching vermilion. Like all other species of the genus, it lives in the gills of the fish it infests.

5. *TRISTOMA PAPILLOSUM*, Diesing.

Tristoma papillosum, DIESING, Nov. Act. Nat. Curios. xviii, 1836, pp. 313-316, pl. xvii, figs. 13-18.

Tristonum papillosum, DIESING, Systema Helminthum, i, 1850, pp. 430-431.

This fluke is oblong in outline. The posterior sucker is quite as large as that of the preceding species, but is situated nearer the posterior margin. The dorsal surface is covered with many little papillary appendages. The animal is about nine-tenths of an inch in length and three-tenths in breadth. Its color is a dusky yellowish white. It lives, in company with the preceding species, in the gills of the Sword-fish and other fishes.

CESTODA.

6. *TETRARHYNCHUS ATTENUATUS*, Rudolphi.

Tetrarhynchus attenuatus, RUDOLPHI, Entozoorum Synopsis, i, 1819, pp. 130, 449, 688.

Tetrarhynchus discophorus, BREMSER, Icones Helminthum, 1824, pl. xi, figs. 14-15.

The tape-worms of this genus possess a very short body, a long and narrow neck, and a head furnished with four long proboscises, armed with a great number of recurved hooks. The species under consideration varies in length from 2 to 5.9 millimeters. The head is somewhat conical in shape, and bears two round and strongly concave suckers. The neck is narrow behind, and transversely rugose. As it is the only species of the genus found in the Sword-fish, it cannot be easily mistaken. It has been found on the gills of the Sword-fish, and also in the walls of the abdomen.

7. *BOTHRIOCEPHALUS XIPHLÆ* (Gmelin) True.

Eohinorhynchus xiphia, GMELIN, Linn. Syst. Nat. vi, 1788, p. 3047.

Bothriocephalus plicatus, RUDOLPHI, Entozoorum Synopsis, 1819, pp. 136, 479, pl. iii, fig. 2.

This tape-worm varies in length from 30 to 300 millimeters. Its head is elongated arrow-shape or fusiform in outline. The anterior articulations of the body are very narrow, but they widen towards the center; the posterior ones, again, are narrow. It usually inhabits the rectum of the Sword-fish, but has been also occasionally found buried in the walls of the intestines.

b. *The Crustacean parasites*.—The Crustacean parasites of the Sword-fish belong to the group known as *Copepoda*. They are five in number.

1. PENNELLA FILOSA (Linn.) Cuvier.

Pennatula filosa, LINN. Syst. Nat. 10th ed. i, 1758, p. 819.

Pennella filosa, CUVIER, Règne Anim. 2d ed. iii, 1830, p. 257.—GUÉRIN,

Iconogr. de Règne Anim. de Cuvier, pt. v (Zoophytes), 1829-'39, pl. ix, fig. 3.

The females of this genus are characterized by the presence of hooks attached to the head—by which they cling to the animal they infest—four pairs of rudimentary feet on the ventral side, and an abdomen very well developed and furnished with a number of penniform appendages, directed obliquely backward. The male is very small and nearly orbicular. The species *P. filosa* has a long, narrow, and straight body, and a large head, carrying behind two short, obtuse hooks.

It fastens itself in large numbers to the gills of the Sword-fish, greatly inconveniencing it in the act of breathing.

2. PENNELLA COSTAII, Richiardi.

Pennella Costaii, RICHIARDI (name only), Expos. Intern. di Pesca, Berlin, Sez. Ital. Cat. 1880, p. 150.

No description of this species is given in the place cited above. It lives in the flesh of the Sword-fish.

3. PHILICHTHYS XIPHILÆ, Steenstrup.

Philichthys xiphie, STEENSTRUP, Soc. R. Scient. Hafn. Act. Consp. 1861, p. 295.

This animal lives in the cavities and canals of the frontal bone of the Sword-fish. The descriptions of this and the two succeeding species were not accessible to me.

4. BRACHIELLA RAMOSA, Richiardi.

Brachiella ramosa (name only), RICHIARDI, Expos. Intern. di Pesca, Berlin, Sez. Ital. Cat. 1880, p. 151.

This parasite hangs on the gills of the Sword-fish.

5. CHONDRA-CANTHUS XIPHILÆ, Cuvier?

Chondracanthus xiphie, GUÉRIN, Icon. Règne Anim. de Cuvier, pt. v (Zoophytes), 1829-'39, pl. ix, fig. 20.—MILNE-EDWARDS, Hist. Nat. des Crust. iii, 1840, p. 504.

This species also lives on the gills of the Sword-fish.

45.—FISH-PARASITES—THE SUCKERS OR REMORAS.

Several species of "stay-ships" or "remoras" occur on our coast. The ordinary kinds, such as *Leptecheneis naucrateoides*, the one with a black stripe down its side and white corners to its caudal fin, appears to choose companionship with the sharks, while the oceanic species, *Echeneis remora*, is most often found clinging to ships.

A third species, *Remoropsis brachyptera*, is the particular parasite of the Sword-fish. I have several times identified it when found attached to the fish, and have never known it to be found on any other species. It has never come to us, moreover, from locality and season which

would be inconsistent with a theory that it had been brought near shore by a Sword-fish.

Still another, *Rhombochirus osteochir*, seems equally inseparable from *Tetrapturus albidus*. This fact is known to the Cuban fishermen, who call it by the name *Pega de los Agujas*, the parasite of the Spear-fish. The two species last referred to are figured in the plates accompanying this article.

Perhaps the two species are not so fixed in their likings that they will change from *Xiphias* to *Tetrapturus*. My friend Professor Giglioli, of Florence, who speaks of *R. brachyptera* as a fish new to the Mediterranean, obtained from Taranto a specimen said to have been taken from the gills (operculum?) of *Tetrapturus belone*.

These parasites probably prefer to cling with their curious suckers to the hard exterior surface of the opercular flap of the Sword-fish.

K.—THE FISHERIES.

46.—THE LOCATION OF THE FISHING GROUNDS.

In what has already been said regarding the dates of appearance and local movements of the Sword-fish in our waters may be found all the facts relating to the location of the fishing grounds, for the fishermen follow the Sword-fish wherever they appear to be most abundant.

Early in the season the Sword-fish are most abundant west of Montauk Point, and later they spread over the shoal-grounds along the coast even as far north as the Nova Scotia Banks. They may be found wherever mackerel and menhaden are abundant, as may be inferred from the almost universal practice of carrying Sword-fish irons on board of mackerel vessels.

I quote the statements of three or four correspondents who have taken the trouble to interview the fishermen of their respective localities.

Mr. E. G. Blackford writes: "The following information I received from an old swordfisherman, a man whose statements may be relied on. The season first opens early in June in the neighborhood of Sandy Hook, and continues along the coast as far east as Martha's Vineyard and Nantuckét Shoals until about the middle of September. They are said to have been caught as far north as Cape Sable. At the first cold wind blowing in September they disappear, and are not found again on the coast that season." This is the statement of a New York man.

Capt. Benjamin Ashby, of Noank, Conn., informs me that the Sword-fish vessels of Noank and New London are accustomed to leave the home-port about the 6th of July, and throughout the month they find fish most abundant between Block Island and Noman's Land; in August between Noman's Land and the South Shoal Light Ship. They first meet the fish twenty to twenty-five miles southeast of Montauk Point. In August and September they are found on George's Banks. There is no fishing after the snow begins to fly.

A little farther east is the New Bedford fleet. Capt. I. H. Michaux, of the schooner "Yankee Bride", tells me that Sword-fish strike in about Block Island in the middle of June, and stay in that vicinity until the 15th or 20th of August. North of Cape Cod they are taken up to the 20th of October.

The statements of Mr. John H. Thomson, of New Bedford, have already been quoted, but may be epitomized in this connection. From May 25 to June they are found south of Block Island, approaching the Vineyard Sound and the neighboring waters through June and to the middle of July. A little later they are more abundant to the southeast of Crab Ledge, and after August 1 to the southeast of Cape Cod and George's Banks.

The schooner "Northern Eagle", of Gloucester, Capt. George H. Martin, when engaged in swordfishing, is accustomed to leave Gloucester so as to be on the ground south of Block Island by the 10th of June, and the fish are followed as far east as Portland.

Mr. Earll ascertained that the Sword-fish are mostly fished for on the coast of Maine from July 1 to September 1.

Halibut vessels on La Have and Sable Island Banks occasionally take these fish upon their lines.

Mackerel vessels on the New England coast are always prepared for Sword-fish when cruising among mackerel schools. I am not aware that they have more than once been seen on the mackerel grounds of the Gulf of Saint Lawrence.

47.—APPARATUS OF CAPTURE.

The apparatus ordinarily employed for the capture of the Sword-fish is simple in the extreme. It is a harpoon with detachable head. When the fish is struck the head of the harpoon remains in the body of the fish, and carries with it a light rope, which is either made fast or held by a man in a small boat, or is attached to some kind of a buoy, which is towed through the water by the struggling fish and which marks its whereabouts after death.

The harpoon consists of a pole 15 or 16 feet in length, usually of hickory or some other hard wood, upon which the bark has been left, so that the harpooner may have a firmer hand-grip. This pole is from an inch and a half to two inches in diameter, and at one end is provided with an iron rod, or "shank", about two feet long and five-eighths of an inch in diameter. This "shank" is fastened to the pole by means of a conical or elongated cup-like expansion at one end, which fits over the sharpened end of the pole, to which it is secured by screws or spikes. A light line extends from one end of the pole to the point where it joins the "shank", and in this line is tied a loop, by which is made fast another short line which secures the pole to the vessel or boat, so that when it is thrown at the fish it cannot be lost.

Upon the end of the "shank" fits somewhat securely the head of the harpoon, known to the fishermen by the names *Sword-fish iron*, *lily-iron*,

or *Indian dart*. The form of this weapon has undergone much variation, as is shown in the series of figures of specimens in the National Museum in one of the accompanying plates. The fundamental idea may very possibly have been derived from the Indian fish-dart, numerous specimens of which are in the National Museum, and one form of which is shown in the plate by the side of the others. However various the modifications may have been, the similarity of the different shapes is no less noteworthy from the fact that all are peculiarly American. In the enormous collection of fishery implements of all lands in the late exhibition at Berlin, nothing of the kind could be found. What is known to whalers as a toggle-harpoon is a modification of the lily-iron, but so greatly changed by the addition of a pivot by which the head of the harpoon is fastened to the shank that it can hardly be regarded as the same weapon. The lily-iron is in principle exactly what a whaleman would describe by the word "toggle". It consists of a two-pointed piece of metal, having in the center, at one side, a ring or socket the axis of which is parallel with the long diameter of the implement. In this is inserted the end of the pole-shank, and to it or near it is also attached the harpoon-line. When the iron has once been thrust point first through some solid substance such as the side of a fish, and is released upon the other side by the withdrawal of the pole from the socket, it is free, and at once turns its long axis at right angles to the direction in which the harpoon-line is pulling, and thus is absolutely prevented from withdrawal. The principle of the whale-harpoon or toggle-iron is similar, except that the pole is not withdrawn, and the head, turning upon a pivot at its end, fastens the pole itself securely to the fish, the harpoon-line being attached to some part of the pole. The Sword-fish lily-iron head, as now ordinarily used, is about four inches in length, and consists of two lanceolate blades, each about an inch and a half long, connected by a central piece much thicker than they, in which, upon one side, and next to the flat side of the blade, is the socket for the insertion of the pole-shank. In this same central enlargement is forged an opening to which the harpoon-line is attached. The dart-head is usually made of steel; sometimes of iron, which is generally galvanized; sometimes of brass.

The entire weight of the harpoon-pole, shank, and head should not exceed 18 pounds.

The harpoon-line is from 50 to 150 fathoms long, and is ordinarily what is known as "fifteen-thread line". At the end is sometimes fastened a buoy, and an ordinary mackerel keg is generally used for this purpose.

In addition to the harpoon, every swordfisherman carries a lance. This implement is precisely similar to a whaleman's lance, except that it is smaller, consisting of a lanceolate blade perhaps one inch wide and two inches long, upon the end of a shank of five-eighths-inch iron, perhaps two or three feet in length, fastened in the ordinary way upon a pole 15 to 18 feet in length.

48.—THE MANNER OF FITTING A VESSEL FOR SWORDFISHING.

The Sword-fish are always harpooned from the end of the bowsprit of a sailing-vessel. It is next to impossible to approach them in a small boat. All vessels regularly engaged in this fishery are supplied with a special apparatus for the support of the harpooner as he stands on the bowsprit, and this is almost essential to success, although it is possible for an active man to harpoon a fish from this station without the aid of the ordinary frame-work. Not only the professional swordfishermen but many mackerel schooners and packets are supplied in this manner.

An illustration of the Sword-fish "pulpit" is given in one of the plates. It is constructed as follows: The harpooner stands upon the tip of the bowsprit, outside of the jib-stay. At this point is fastened a square plate of iron as wide as the bowsprit. In the middle of this plate is a mortise two inches square and extended three or four inches down into the wood, forming a socket for an upright iron bar two inches square and three feet high. At the top of this bar is a bow of iron bent backward in semicircular form to surround the waist of the harpooner, the ends of the bow being separated by a distance of perhaps two feet. In the ends of the bow-iron are holes through which are passed irons to hold the dart when not in use. Through these same holes are sometimes passed ropes, by which is suspended a swinging seat for the use of the harpooner when not in action. When not in use the dart is lashed in a horizontal position to the top of the "rest". The lance is usually allowed to rest against the jib-stay, to which it is secured by passing it through loops of rope arranged for the purpose. Upon the tip of the bowsprit, at the base of the *rest*, is a platform of wood about two feet square, large enough to afford a firm foot-hold to the harpooner. The harpoon-line is coiled upon the bow of the vessel, the buoy usually resting upon the bulkhead or close at hand. A second harpoon-line, attached to the reserve or second harpoon, is coiled upon the other side.

The structure above described is usually called a "rest", though not infrequently the "pulpit". Capt. Benjamin Ashby always called it an "oresembo". I was unable to obtain from him any derivation of this remarkable word. He informed me that he had always used this name because the thing looked to him as if it ought to be called by that name, and that he had never heard any one else call it so except members of his own crew, who had learned the word from him. This is a curious illustration of the arbitrary manner in which fishermen are accustomed to coin names for new articles of apparatus. Although many archaic and provincial terms whose etymology is plainly traceable are in use among our sea-faring men, there are numerous others for whose meaning and origin it would be vain to search.

I have been unable to learn when and by whom this peculiar piece of apparatus was devised.

49.—MANNER OF CAPTURE.

The Sword-fish never comes to the surface except in moderate, smooth weather. A vessel cruising in search of them proceeds to the fishing ground, and cruises hither and thither wherever the abundance of small fish indicates that they ought to be found. Vessels which are met are hailed and asked whether any Sword-fish have been seen, and if tidings are thus obtained the ship's course is at once laid for the locality where they were last noticed. A man is always stationed at the masthead, where, with the keen eye which practice has given him, he can easily descry the tell-tale dorsal fins at a distance of two or three miles. When a fish has once been sighted, the watch "sings out", and the vessel is steered directly towards it. The skipper takes his place in the "pulpit", holding the pole in both hands by the small end, and directing the man at the wheel by voice and gesture how to steer. There is no difficulty in approaching the fish with a large vessel, although, as has already been remarked, they will not suffer a small boat to come near them. The vessel plows and swashes through the water, plunging its bowsprit into the waves, without exciting their fears. Noises frighten them and drive them down. Although there would be no difficulty in bringing the end of the bowsprit directly over the fish, a skillful harpooner never waits for this. When the fish is from 6 to 10 feet in front of the vessel it is struck. The harpoon is never thrown, the pole being too long. The strong arm of the harpooner punches the dart into the back of the fish, right at the side of the high dorsal fin, and the pole is withdrawn and fastened again to its place. When the dart has been fastened to the fish the line is allowed to run out as far as the fish will carry it, and is then passed in a small boat which is towing at the stern. Two men jump into this, and pulling in upon the line until the fish is brought in alongside, it is then killed with a whale-lance or a whale-spade, which is stuck into the gills.

The fish having been killed, it is lifted upon the deck by a purchase-tackle of two double blocks rigged in the shrouds.

The fishermen have a theory to the effect that the Sword-fish can see nothing directly in front of him, on account of the peculiar location of the eyes, and there are instances of their having been approached, and killed, by men in a skillfully-managed dory.

50.—THE PERILS AND THE ROMANCE OF SWORDFISHING.

The pursuit of the Sword-fish is much more exciting than ordinary fishing, for it resembles the hunting of large animals upon the land, and partakes more of the nature of the chase. There is no slow and careful baiting and patient waiting, and no disappointment caused by the accidental capture of worthless "bait-stealers". The game is seen and followed, and outwitted by wary tactics, and killed by strength of arm and skill. The Sword-fish is a powerful antagonist sometimes, and sends

his pursuers' vessel into harbor leaking, and almost sinking, from injuries which he has inflicted. I have known a vessel to be struck by wounded Sword-fish as many as twenty times in one season. There is even the spice of personal danger to give savor to the chase, for the men are occasionally injured by the infuriated fish. One of Captain Ashby's crew was severely wounded by a Sword-fish which thrust his beak through the oak floor of a boat on which he was standing, and penetrated about two inches in his naked heel. The strange fascination draws men to this pursuit when they have once learned its charm. An old swordfisherman, who had followed the pursuit for twenty years, told me that when he was on the cruising ground he fished all night in his dreams, and that many a time he has bruised his hands and rubbed the skin off his knuckles by striking them against the ceiling of his bunk when he raised his arms to thrust the harpoon into visionary monster Sword-fishes.

51.—A LANDSMAN'S DESCRIPTION OF SWORDFISHING.

Mr. C. F. Holder, of New York, published in the New York "Forest and Stream", February 17, 1876, the following description of a trip after Sword-fish in Block Island Sound:

"Lying all night in the harbor of Wood's Holl, we had ample time to prepare for sport, and at three o'clock in the morning our little sloop was swinging around, and, gathering herself together, headed for Gay Head. The vessel was a common sloop of about sixty tons, its only peculiarity being a stanchion with a curved top, to hold the harpooner, rigged on the extreme end of the bowsprit. At nine o'clock we were out of sight of the Vineyard. The wind settling, I was informed that I could go aloft and use my weather-eye, and the better I used it the more fish we would get. After not a few attempts to climb the greasy pole of a mast I found myself aloft, with a firm grasp upon the throat of the gaff, my weather-eye, contrary to orders, full of tar, and my port one on the lookout for the game. We were just moving along, and I was taking in the horizon for miles around, when the man at the bow uttered a sound, which was a sort of a cross between a cluck and a groan, which I saw meant 'port', and that something had been sighted. The old craft fell lazily away, and I then saw two dark forms with their razor-like fins out of the water slowly moving along ahead of us. The captain signalled at once for me to come down, and as I reached the deck the fun commenced. The man waited until we were almost upon them, and as one of them turned, as if in idle curiosity, to see what the great shadow meant, he hurled a spear, and the next moment the huge fish sprang from the water and with a furious twist tried to shake out the iron. So great was the effort that it fell on its side with a crash, and for a moment was still, but it was only for a second. The line jumped into activity and rushed out so you could not follow it, now swaying to and fro, and making the water fly like rain. About 50 feet of line had

gone out, when six of us managed to get a fair hold on the line, and attempted to try our strength. If six individuals were ever jerked around in a more vivacious manner they have my utmost sympathies. Now the Sword-fish would land us altogether in a heap, then slacken up, and take us unawares, throwing us to the deck with a force that fully came up to my preconceived ideas of the sport. He would undoubtedly have dragged us all overboard if the rope had not been sure and fast. This sort of fun was kept up for about fifteen minutes, when the fish perceptibly weakened, and the long rushes to the right and left grew feebler and feebler, until we ventured to haul in. At last we had the brute alongside. A rope was rigged from the peak and fastened around the long sword, and the monster was rolled on board the sloop. We measured our game, which was 9 feet 6 inches long. Though I have frequently caught sharks which measured 13 feet, I never saw any that showed near the strength of this peculiar creature.

"We cruised about all day in the vicinity, and succeeded in capturing three more, varying in length from 6 to 9 feet, and as we returned to Wood's Holl I felt that I had well earned my experience."

52.—THE CAPTURE OF SWORD-FISH BY HOOK AND LINE.

One or two instances are on record of the capture of Sword-fish upon an ordinary hand-line, and it is probable that this is much more common than has been usually supposed. Capt. George H. Martin, of Gloucester, informed me that he had seen seven caught in this manner in one day in the South Channel. They were caught in water fifteen to twenty-five fathoms deep, on the old-fashioned George's cod-hook, with a six-inch shank. Mackerel were used for bait; these were split down the tail so that the shank of the hook could be entirely hidden in the gash.

I have been told that they are also taken in this way about Block Island, and a similar method of fishing is described by Italian writers.

Within the past three years it has not been unusual for Sword-fish to become entangled in the long lines of the halibut fishermen on the northern banks. The manner in which this occurs has already been discussed above.

I have collected several instances. In 1877, in the month of August, Capt. Daniel O'Brien, of the schooner "Ossipee", of Gloucester, fishing in 200 fathoms of water, between Le Have and Western Bank, caught, in one voyage, five Sword-fish.

At about the same time, Capt. R. L. Morrison, of the schooner "Laura Nelson", fishing in 275 fathoms, on Sable Island Bank, caught three Sword-fish. Another vessel, in August, 1877, fishing on Le Have, in from 175 to 180 fathoms, caught twelve, as well as three or four more in September. August 17, 1878, Capt. Joseph W. Collins, of the schooner "Marion", fishing on the southwest prong of Banquereau, in 200 fathoms of water, caught one Sword-fish; again, on October 1, fishing south-

east of Sable Island, in 175 fathoms, caught one Sword-fish on his trawl and saw several others swimming at the surface; October 8, caught another on Banquereau, in the locality first mentioned. In August, 1878, Captain Greenleaf, of the schooner "Chester R. Lawrence", of Gloucester, fishing in 140 fathoms, caught thirteen in one trip. I cannot learn that this manner of capture was ever known before 1876, but it has since become so frequent that it excites no remark for a halibut-catcher to unload several Sword-fish among its halibut. This manner of taking the Sword-fish is of course purely accidental, and is rather a vexation than otherwise to the fishermen. It is probable that the fish take the bait when the line is being set and they are swimming near the surface, and they are involuntarily carried down by its great weight.

53.—SWORD-FISH VESSELS.

The vessels engaged in swordfishing are sloops and small schooners of generally less than fifty tons. The crew is also small, consisting of two or sometimes three men besides the cook and a boy. Although many vessels are employed in this fishery for several successive years, there are many others which fit out for a single season or for a part of a season. Others, on the south coast of New England, divide their time between fishing for sea-bass and hunting for Sword-fish, all warm and quiet days being devoted to the latter pursuit. Six or eight vessels from New London are thus employed, as well as others from Noank and Bridgeport. On the coast of Maine, as has already been mentioned, many of the smaller fishing vessels fitted for the capture of mackerel and cod devote a part of the season to swordfishing. Other vessels, among them occasionally a gentleman's yacht, enter the field for a cruise or two in the course of a summer. To do this is a favorite recreation for old swordfishermen engaged in other work. Numerous mackerel schooners carry the Sword-fish "pulpit" on their bows, and so do various coasters and packets.

It has therefore not been thought desirable to attempt to make a list of the vessels engaged in the swordfishery, or even an exact enumeration of them. In 1879 estimates by careful men engaged in the business fixed the number belonging in different ports as follows:

New York (hauling from New London)	2
Greenport (sloops)	2
New London	8
Newport	1
Fall River	2
Cuttyhunk	3
Westport	2
New Bedford	13
Dartmouth	2
South side of Cape Cod	5
Total	41

In 1874, according to Mr. Thompson, New Bedford had twelve vessels in this fishery. In 1877 the estimates of total number of vessels made by different men varied between thirty and forty.

To show how uncertain the continuance of vessels in this fishery may be I will refer to the annals of Gloucester. In 1876, one schooner, the "Meteor", was engaged; in 1877, the schooner "Champion"; in 1878, the schooner "Northern Eagle"; while in 1879 and 1880 the field is abandoned by this port.

54.—FINANCIAL PROFITS TO FISHERMEN.

I have before me the record of a single schooner for the season of 1878, from which it appears that in the season of four months eight trips were made, averaging about twelve days in continuance. One hundred and sixty-three fish were taken between June 7 and September 20, weighing, in the aggregate, in round numbers, about 47,000 pounds, dressed. These were sold at an average price of three cents per pound. The gross stock of the season would amount to about \$1,300. From this must be deducted the expense of living, the interest on capital invested, and the wages of the cook and the boy. The remainder would probably not exceed eight or nine hundred dollars, and the profits have to be divided among the two or three men composing the crew and the owner of the vessel. It is not probable that many vessels stock as large a proportionate amount as did the "Northern Eagle". The success of one New Bedford vessel in the season of 1878 was spoken of as extraordinary, the return being \$311 to each of the crew's share.

The price of Sword-fish is low, and the success of the voyage is always somewhat precarious. A few small vessels with experienced skippers apparently succeed in making a fair living, but that the profits are not great is clearly indicated by the fact that there is no great increase in the number of vessels engaged, and that so many are constantly undertaking and abandoning the swordfishery.

55.—HISTORY OF THE AMERICAN SWORDFISHERY.

There are few data upon which to found conjecture as to the time when the Sword-fish came to be regarded as sufficiently useful to be sought for by fishermen. One of the earliest records of its use for food is found in the *Barnstable Patriot* of June 30, 1841, in which it is stated that the fishermen of the island south of Cape Cod take a considerable number of these fish every year by harpooning them, and that about two hundred pounds a year are pickled and salted at Martha's Vineyard.

Captain Atwood remembers seeing Sword-fish on the coast of Maine as early as 1826, although up to the time of his retirement from active participation in the fisheries, in 1867, no effort was made by the fishermen north of Cape Cod to capture them.

The fishery apparently sprang into existence and importance between

the years 1840 and 1855, upon the south coast of New England. Captain Ashby first engaged in it in 1859, when it was apparently a well-established industry. In 1861 it is recorded that some thirty vessels from New Bedford were profitably engaged in this business on the favorite ground, 15 to 20 miles southeast of Noman's Land.*

Mr. Earll ascertained that little attention was paid by the fishermen of Portland, Me., to Sword-fish until within two or three years. This fishery is carried on at odd times by mackerel gill-net fishermen, and by cod-trawling vessels when their regular industry is interfered with by the abundance of dog-fish. The season for dog-fish is also the time for Sword-fish, and at the present time, when the price of Sword-fish justifies it, smaller fishermen, when they are driven from their regular work by the dog-fish, make trips for the express purpose of capturing Sword-fish. Mackerel-seiners are beginning to carry Sword-fish irons, and are often very successful in killing the fish.

At the present day, and for five or six years past, perhaps much longer, there has been very little change in the number of vessels engaged, this varying from thirty to forty approximately in different years.

Capt. Epes W. Merchant, of Gloucester, who has been familiar with the fisheries since 1804, tells me that the first Sword-fish ever brought to Gloucester within his recollection was caught on George's Bank about the year 1831, by Captain Pugh, who brought it in and sold it at the rate of eight dollars a barrel, salted. Fishermen had before that been very much afraid of them, but afterwards a good many were caught.

56.—THE CAPTURE OF THE SWORD-FISH IN THE MEDITERRANEAN.

M. Victor Meunier, in his little treatise, "Les Grandes Pêches", p. 141, describes the various methods formerly and at present in use in the fisheries of the Mediterranean. The Greeks were accustomed to use boats with projecting bows, modeled to resemble a Sword-fish, and painted with its peculiar colors. This the unsuspecting fish would approach, thinking to meet one of its own kind. The fishermen, taking advantage of the mistake, would pierce it through and through with their lances. Although surprised, the Sword-fish would defend itself with vigor, striking the treacherous boat with its sword and endangering its safety, while the fishermen strove to seize it by the head and, if possible, to cut off its sword. Having overcome their captive, they would fasten it behind their boat and carry it ashore. Oppian compared

* "Sword-fish have been taken this season in large numbers. New Bedford vessels have made a good thing in them. Few of the boats failed to take one or two daily. Captain Cobb, of the pilot-boat 'Vision', in a day and a half took nine, the largest weighing 400 pounds. Thirty vessels are fifteen miles south and east of Noman's Land, or sixty miles out from New Bedford, and same distance from Nantucket. The season extends from June to September. The fish generally weigh 400 or 500 pounds, and are from 10 to 12 feet long. They are sold in New York. After a fish is harpooned it scuds away, with a coil of rope paying out, and sometimes an hour is used before he is brought on board."—*Barnstable Patriot*, Aug. 20, 1861.

this method of fishing to a military stratagem. This ruse was known also to the Romans, and in their time the swordfishery was one of the most important. They also captured these fish in *madragues*, in which they were easily entangled while pursuing tunnies and other fishes of the mackerel tribe. "Although he is able to break the nets," said Opiian, "he shrinks from it; he fears some snare, and his timidity counsels him ill; he ends by remaining a prisoner within the ring of the net, and becomes the prey of the fishermen, who with united effort drag him to the shore." This does not always occur, to be sure, for often, to the grief of his would-be captors, he breaks the walls of his sepulcher, liberating also the other fishes buried with him.

There is at the present day a fishery in the Straits of Messina, continuing on the Calabrian shore from the middle of April to the latter part of June; on the Sicilian shore from the first of July to the end of September. The Calabrian fish appear to approach by the Pharos, the Sicilian ones by the southern entrance of the straits. This summer fishery has for its object the capture of the large fish, which are killed with a lance. The boats used are about 18 feet long, 4 feet deep, and broader at the stern than at the bow. There is a single mast, 17 feet high, surmounted by a brace of a curved form, intended to support the lookout, who gains access to it by steps fastened to the mast. The lookout from this elevated station views the movements of the fish, and by voice or gesture directs the movements of the oarsmen. At the proper time he descends, and standing on a narrow thwart amidships he aids the waist-oarsmen and performs the office of steersman.

At the bow stands the man who strikes the fish. His lance is about 12 feet long, with an iron head, which, from the vague description of Meunier, appears to resemble closely the American lily-iron. This is detachable, and to it is fastened a line as thick as one's little finger and 600 feet long (200 meters).

Two guards are also stationed on the shore. On the Calabrian coast they climb upon high rocks and cliffs; on the opposite shore, where there are none, they stand on a tower, built expressly for this purpose, about 800 feet in height.

"Everything being arranged," says Spallanzani, "behold the order of the fishery. When the two watchmen perched upon the tops of the rocks or of the mast judge that a Sword-fish approaches from afar, by the change in the color of the water, at the surface of which he swims, they signal with the hand to the fishermen, who row toward it with their boats, and they do not cease to cry out and to make signs until the other lookout on the mast of the boat has perceived the fish and follows it with his eye. At the voice of the latter the boat veers now to the right, now to the left, until the lancer, standing at the bow, weapon in hand, catches sight of the fish. Now the lookout descends from his mast, stations himself among the oarsmen, and directs their movements in accordance with signals given him by the lancer; he, seizing a favorable oppor-

tunity, strikes the fish, often at the distance of 10 feet. Immediately he slackens out the rope, which he holds in his hands, while the boat, with the force of all its oars, follows the wounded fish until he has expended all his strength. Then he rises to the surface; the fishermen, approaching, fasten to him with an iron hook and carry him to the shore. Sometimes the fish, furious from his wound, strikes the boat and pierces it with his sword, so the fishermen stand on their guard, especially if the animal is large and active."

The young fish are captured in nets about 300 feet long, called *palmadaras*. These are stretched between two boats with lateen sails, moving along, entangling in their meshes everything which they touch. Spallanzani protested vehemently against this fishery. It is carried on from October to March.

Oppian describes a method of capture used in the Mediterranean. A bait was fastened with a sliding noose to the line at a distance above the naked hook, and the whole was so contrived that when the Swordfish seized the bait with its mouth the hook seized it from behind with great force. This story is declared by writers of the present day to have been fanciful and without foundation.

I am indebted to Mr. Frederick W. True for the following translation from Prof. Adolfo Targioni Tozzetti's essay on "The Fisheries of Italy", published in 1870,* which gives briefly a description of the methods now employed in the vicinity of Messina and elsewhere on the Italian coast:†

"Swordfish are taken from time to time, together with the tunnies, in the *tonnare*; ‡ but hook-and-line and gill-net fisheries are also carried on, the methods of which we may describe somewhat at length.

"Two very distinct fisheries are prosecuted—one by day, the other by night. The former is carried on by means of peculiarly constructed nets called *palamitare*; the latter by the use of harpoons, or *draffiniere*, as they are called. The harpoon fishery is prosecuted in the Straits of Messina, on the coasts of Calabria and Sicily, and among the Eolian Islands.

"The fish appear earliest along the coasts of Calabria, between Gioia Tauro, Palmi, Bagnara, and Scilla, and hence it is in these localities that the fishery first begins. It is prosecuted later in the season on the Sicilian coast, between S. Teresa al Faro, Gazzi, Salvatore dei Greci, and Capo Peloro.

"The net fishery on the Calabrian coast is carried on most extensively between Palmi and Scilla, the harpoon fishery between Palmi and Capo

La Pesca nei Mari d'Italia e la Pesca all'Estero Esercitata da Italiani. < Catalogo degli Espositori e delle cose esposte, Sezione Italiana, Esposizione Internazionale di Pesca in Berlino, 1880. Firenze, Stamperia Reale, 1880, pp. xv-cxxxvi.

Swordfish Fishery—Pesca della Pesce spada, pp. lxxix-lxxxiii.

†The author states that the material for the following article is derived from the writings of Duhamel, Oppian, Spallanzani, and Vetrioli.

‡A kind of pound-net constructed for the capture of tunnies or horse-mackerel (*Oreogmus thynnus*).

delle Volpi. On the Sicilian coast nets are employed principally between S. Teresa and Gazzi, but between Salvatore dei Greci and Capo Peloro, where the management of nets would be very difficult on account of the deep water and rapid currents, the harpoon fishery prevails.

"The season of the regular fishery in Calabria extends from the middle of April to the end of June, and in Sicily from the middle of July to the middle of August. The capture of young Sword-fish, however, continues to increase long after this time, the season often extending to the middle of October. Fish weighing little more than a single kilogram are frequently taken, and the practice, therefore, has been strongly censured. In the latter part of October both adult and young fish disappear, retreating, as many suppose, to the depths of the ocean. They reappear in spring prior to spawning time, and remain on the fishing grounds throughout the entire season.

"Fisheries are also carried on, but with more or less irregularity, among the Liparian Islands, near Tropea, in Calabria, in the tunny-nets of Milazzo, Oliveri, and S. Giorgio, near Patti, and in the waters of Sardinia.

"The fishery on the Sicilian and Calabrian coasts is prosecuted at certain fixed stations. At some of them, such as station 25, in Calabria, net and harpoon fisheries are carried on with equal success; but at others, as for instance at station 21, in Sicily, only the harpoon fishery can be prosecuted, and at others, again, as at station 20, the net fishery alone prospers.

"The stations are occupied by the gangs (*poste*) of fishermen. The conformation of some portions of the coast of Calabria is such that the day fishery with nets cannot be carried on, and at these points each gang comprises two boats, or feluccas, of from 10 to 16 tons, two skiffs for each felucca, and one additional skiff used in carrying on communication between the boats.

"The *palamitara* is set from time to time, and at each station is fitted up in the manner deemed most suitable by the fishermen. It is made of strong hemp twine, and is hung to two ropes, the upper being buoyed by cork floats and the lower weighted with leads. The length of the net varies between 600 and 800 meters, the breadth is 16 meters, and the area 14,000 to 15,000 meters, more or less, according to the depth of water, which on these coasts varies between 40 and 600 meters; the mesh measures about 17 centimeters, bar. Each end of the upper rope is tied to a large cork buoy, to which a bell is attached, which sounds with every motion of the net.

"By these arrangements the net has sufficient play, so that it is not liable to injury by the sea. At the same time, when a fish strikes the net and is gilled, the more it struggles to get free the more it becomes entangled. In the mean time the ringing of the bell gives the fishermen the signal that a fish is captured, and they hasten to free the net and set it again.

"The method of the harpoon fishery is very different. A watchman is employed, who has his station on the cliffs overlooking the water, or at the masthead of the felucca. The mast of the felucca is usually 20 meters or more in height, and the watchman climbs to his station by means of a rope ladder. From his elevated position he scans the sea far and near, and when he perceives a Sword-fish gives the signal to a lookout, called *fariere*, *foriere*, or *foliere*, standing at the masthead of some one of the boats, or *lontro*, at the station.

"The watchman indicates the movements of the fish by certain signals. For instance, he cries out '*va susu*', meaning that the fish goes yonder, or toward Il Faro; or '*va jusu*', he goes down, that is, toward Messina; or '*va fora*', he goes out, or toward Levante; or sometimes '*va n'terra*', meaning that the fish is swimming toward the shore.

"The lookout, at first obeying these signals, and then relying on his own observation, guides the *lontro* toward the fish. When the boat has approached sufficiently near, the harpooner strikes the fish with his *draffiniera*, or harpoon.

"The *draffiniera* consists of a wooden staff 12 feet long, furnished with an iron 7 inches in length. The iron has two wings, and is constructed in such a manner that when it strikes the fish the point enters the flesh and the wings spread in the wound.* A rope, or *protese*, often 600 feet or more in length, is fastened to the harpoon-head, so that it may be recovered when the fish, weakened by loss of blood, is captured and brought into the boat.

"A short warp is tied to the staff of the harpoon, by which when the head is detached it is brought back into the boat. After the fish is struck, the *lontro* puts back to the station, leaving the chase and capture of the wounded fish to a second boat. Usually he is easily captured, but sometimes by dashing against the boat, or by other movements he manages to free himself and make his escape.

"A fishery very similar to that carried on at the present time was described by Polibius, according to Strabo, more than two thousand years ago. The account of the fishery at Messina given by Oppian† is somewhat fanciful and inaccurate, but in the last century Spallanzani gave a more strictly technical description of it.‡ Recently the fishery has been accurately described in elegant Latin verse by Vetrioli.§

"The following table gives the number of fishermen and boats engaged in the Sword-fish fishery on the Sicilian and Calabrian coasts:

1. *The harpoon fishery.*

	Calabria.	Stilly.
Large boats (or feluche)	6	52
Small boats (lontri)	26	52
Small boats (barche)		52
Fishermen	275	384

* This iron resembles closely the American lily-iron.
 † Oppiano, *Dolla Pesca*, lib. iii.
 ‡ Spallanzani, *Viaggi alle due Sicilie ecc.* vol. iv, p. 308, et seq.
 § Vetrioli, *Xyphias Carmen*, Naples, 1870.

2. *The gill-net fishery.*

	Calabria.	Sicily.
Boats of three tons burden	80-90	50
Fishermen	650	400

"The fishery is extremely productive. On the coasts of Sicily a gang of fishermen frequently capture fifty fish, each weighing from 100 to 200 kilograms, in a single day, and on the Calabrian coast, 20 fish.

"The following table shows the average annual catch in Sicily and Calabria :

1. *The harpoon fishery.*

	Kilograms.
On the Calabrian coast	60,000
On the Sicilian coast	40,000

2. *The gill-net fishery.*

On the Calabrian coast.....	25,000
On the Sicilian coast	15,000

"The products of the fishery are consumed principally in Sicily and on the mainland of Italy. A portion, however, is preserved in salt or oil, and sometimes exported. The flesh of the Sword-fish is excellent when fresh, and is not so liable to become soft when canned as that of the tunny or horse-mackerel. It, therefore, always commands a high price.

"It has been claimed that, in order to prevent a decline in the fishery, hook-fishing should be prohibited from the middle of January to the first of April, and that a fine should be imposed on those who capture the young fish. It has been suggested also that no nets should be allowed to be set in the Straits of Messina within 200 meters from the shore.

"The result of the experiments in artificial hatching of Sword-fish in certain inclosures and marshes in the vicinity of Il Faro appears to be somewhat uncertain ; but, at all events, they may open the way for more practical and successful operations in the future."

L.—PRODUCTS OF THE FISHERY.

57.—RECORD OF A GLOUCESTER SCHOONER FOR THE SEASON OF 1878.

As an example of the manner in which a season of swordfishing is passed, and of the yield of a very successful period of work, a record is here given of the trips of the schooner "Northern Eagle", of Gloucester, Capt. George H. Martin.

Trips of schooner "Northern Eagle", Capt. George H. Martin.

No. of trips.	Date of start.	Length of trip.	No. of fish taken.	Where sold.	Price.
		<i>Days.</i>			<i>Cents.</i>
1	June 7	10	16 (5,000 lbs.)	Boston.....	3
2	June 19.....	7	22 (6,600 lbs.)	do.....	4½
3	June 30.....	14	12 (3,700 lbs.)	Newport.....	2½
4	July 12.....	11	20 (5,800 lbs.)	Boston.....	3
5	July 27.....	18	37 (9,000 lbs.)	do.....	5
6	August 15.....	15	20 (5,500 lbs.)	do.....	3
7	September 1.....	16	16 (5,000 lbs.)	do.....	(2)
8	September 20.....	14	14 (4,500 lbs.)	do.....	(3)
			163 (48,700 lbs.)		

58.—RESULTS OF TRIPS BY OTHER VESSELS.

Capt. Benjamin Ashby went swordfishing in the schooner "N. H. Dudley" two successive years, in 1859 and 1860. In July and August, 1859, he took 108 fish; the next year 88.

The schooner "Yankee Bride", of New Bedford, visited in Provincetown Harbor, August, 1879, had already that season taken 60 fish.

Mr. Earll reached Portland in the progress of the fishery census investigation, July 29, 180. On this day, he writes, 35 to 40 fish were brought in, and on the 1st of August 200 more were landed, 60 by one vessel.

59.—STATISTICS OF CAPTURE.

It is at present only possible to give estimated statistics of capture, though a year hence, when the returns of the fishery census, at present in progress, shall have been tabulated, much more accurate figures will be attainable. Putting the number of vessels regularly employed in swordfishing at forty, estimating their annual catch at eighty fish each, which is only half the quantity taken by the "Northern Eagle", as shown in the preceding paragraph, the aggregate number of fish taken would be 3,200.

Competent authorities estimate that each vessel in the mackerel fleet captures and brings in an average quantity of eight barrels of pickled fish, or perhaps eight fish each. The number of vessels in the mackerel fleet is at least four hundred. Allowing four fish to each, there is an aggregate of 1,600 fish. Estimating one for each vessel in the halibut fleet yearly, we add fifty more in the aggregate.

Mr. Earll judged that in 1878, as for several years previous, 2,000 Sword-fish had been brought into Portland, Me. Allowing 1,000 of these to the regular swordfishermen and the mackerel vessels, we have a remainder of 1,000 taken by the occasional fishermen of Portland already spoken of, and to be added to the aggregate, which now amounts to 5,850.

Add 150 more for the coasters, sea-bass fishermen, and pound-tending vessels of Southern Massachusetts, Rhode Island, and Connecticut, and the sum is 6,000.

The average weight of a Sword-fish dressed is estimated by several persons, Captain Ashby, Mr. Earll, Mr. Thompson, and others, to be 300 pounds, and that this is not far from the truth may be seen by referring back to the records of the "Northern Eagle". If the average weight is assumed to be 250 pounds, the aggregate weight of a year's catch of Sword-fish amounts to 1,500,000 pounds, valued at \$45,000, the average price being estimated at three cents per pound.

To estimate the number of men employed is almost impossible, since the season continues only four months, and many are employed for a much shorter period. The crews of the forty vessels number from 160

to 200; the number of men employed for shorter periods it seems scarcely necessary to estimate.

In 1874 the annual catch for the United States was estimated by Mr. E. G. Blackford at 2,000 fish, weighing 1,000,000 pounds.

M.—ECONOMICAL USES AND THE MARKETS.

60.—SWORD-FISH AS AN ARTICLE OF FOOD.

“The small Sword-fish is very good meat,” remarked Josselyn, in writing of the fishes of New England in the seventeenth century. Since Josselyn probably never saw a young Sword-fish, unless at some time he had visited the Mediterranean, it is fair to suppose that his information was derived from some Italian writer.

It is, however, a fact that the flesh of the Sword-fish, though somewhat oily, is a very acceptable article of food. Its texture is coarse; the thick, fleshy, muscular layers cause it to resemble that of the halibut in consistency. Its flavor is by many considered fine, and is not unlike that of the bluefish. Its color is gray. The meat of the young fish is highly prized on the Mediterranean, and is said to be perfectly white, compact, and of delicate flavor.* Sword-fish are usually cut up into steaks, thick slices across the body, and may be broiled or boiled.

Considerable quantities of Sword-fish are annually salted in barrels in Portland, Gloucester, Boston, New Bedford, and New London. Sword-fish pickled in brine is in considerable demand in certain sections of the country, and particularly in the Lower Connecticut Valley, where a barrel may be found in almost every grocery store. By many persons it is considered much more palatable than salted mackerel. The following table gives the amounts of Sword-fish, by barrels, pickled and inspected in Massachusetts from 1805 to 1877. It will be observed that before 1839 none were packed. In 1872, 1,245 barrels, or 249,000 pounds, were put up. The average amount to the year is 93,490 pounds, or about 467 barrels; the total for the thirty-nine years, 3,645,732 pounds:

* The flesh, which is much esteemed by the better classes at Palermo, is dressed in almost as many modes as that of the tunny, and fetches a higher price. During our sojourn there it was as two to one, the price of the first averaging four pence per *robolo*, while the *poromai* of the latter were disposed of at two pence or two pence-half-penny. The fiber is invitingly white, and the round segments look, as they lie in rows along the stalls, like so many fillets of veal. Four to six feet is the usual run of those taken off the Trinærian coast and displayed in the fish markets of Sicily.—*Badham*.

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Number of barrels of Sword-fish inspected in Massachusetts from 1839 to 1877, inclusive.

Inspection ports.	Jan. 1, 1839, to Jan. 1, 1840.	Jan. 1, 1840, to Jan. 1, 1841.	Jan. 1, 1841, to Jan. 1, 1842.	Jan. 1, 1842, to Jan. 1, 1843.	Jan. 1, 1843, to Jan. 1, 1844.	Jan. 1, 1844, to Jan. 1, 1845.		During 1845.	During 1846.	During 1847.	During 1848.	During 1849.
						No. 1.	No. 2.					
Rockport					4							
Newburyport												
Ipawich												
Gloucester			14	10		28	4	26				
Beverly												
Salem												
Marblehead												
Boston	42	97	23	27	190	120	6	200		2		3
Hingham						7		23				
Cohasset		49	85		44	6						16
Scituate		5										
Duxbury												
Plymouth												
Harwichport												
Sandwich												
Barnstable		84										
Provincetown		21		4	10	14						45
Truro			6		27			37		12½		46
Wellfleet		5	4	3	22	17		87		24		23
Harwich		20								49½		223
Chatham	10	78	44	59	56	100						28
Dennis	40	260	128	137	75	141		145		15½		90
Yarmouth												
West Fishbury												
Swansey												
Nantuolet												
Dartmouth												
Total	92	500	254	240	428	452		477	550½	103½	805½	474

Inspection ports.	During 1850.	May 17, 1851, to Dec. 31, 1851.	During 1852.	During 1853.	During 1854.	During 1855.	During 1856.	During 1857.	During 1858.	During 1859.	During 1860.	During 1861.
	Rockport											
Newburyport												
Ipawich												
Gloucester	2											
Beverly												
Salem												
Marblehead												
Boston	15	13							2			
Hingham												
Cohasset		14										
Scituate												
Duxbury												
Plymouth												
Harwichport										5		
Sandwich												
Barnstable												
Provincetown	12								6			
Truro	12											
Wellfleet	6	10										
Harwich	87	63								2½		18
Chatham	8	37½							218½	76½	445½	59
Dennis	52	24							102	8		1½
Yarmouth												
West Fishbury												
Swansey												
Nantucket												
Dartmouth												
Total	144	1052	1,111	821½	284½	534½	216½	404½	236½	91½	445½	76½

Number of barrels of Sword-fish inspected in Massachusetts, &c.—Continued.

Inspection ports.	During 1862.	During 1863.	During 1864.	Jan 1, 1865, to Dec. 1, 1865.	Dec. 20, 1865, to Dec. 20, 1866.	Dec. 21, 1866 to Dec. 20, 1867.	Dec. 21, 1867 to Dec. 20, 1868.	Dec. 21, 1868, to Dec. 20, 1869.	Dec. 21, 1869, to Dec. 20, 1870.
Rockport									
Newburyport									
Ipawich									
Gloucester	9½	8		134½		25½	23½	24	79
Beverly									
Salem									
Marblehead									
Boston	7½	2½		2	10	54½	197½	104½	187½
Hingham							80½	57½	16½
Coliasot		6		89	20½	3		6½	86½
Scituate									
Duxbury									
Plymouth									
Harwichport									
Sandwich									
Barnstable									
Provincetown			10	121½		54	850	142½	309½
Truro									
Wellfleet						99	154½	167½	295½
Harwich	6	95	16½	202½	62½	96½	160	110½	195½
Chatham	481½	49½	42½	69½	21½	21½	21½	35	28
Dennis	61	104½	104	293½	70½	162½	214½	123	87
Yarmouth									
West Fisbury									
Swansey									
Nantucket				82	28½	21	127	13½	9
Dartmouth					6½				89½
Total	565½	259½	172½	804½	225½	538½	1,843½	845½	1,163

Inspection ports.	Dec. 21, 1870, to Dec. 20, 1871.	Dec. 21, 1871, to Dec. 20, 1872.	Dec. 21, 1872, to Dec. 20, 1873.	Dec. 21, 1873, to Dec. 20, 1874.	Dec. 21, 1874, to Dec. 20, 1875.	Dec. 21, 1875, to Dec. 20, 1876.	Dec. 21, 1876, to Dec. 20, 1877.	Total for each town.	Grand total.
Rockport			5	5		5	4	23	
Newburyport			2½					2½	
Ipawich									
Gloucester	90½	200½	102½	86	40½	80½	84½	978	
Beverly									
Salem	81½				1½			83	
Marblehead									
Boston	97½	95½	10½	57½	143½	76½	50½	1,918½	
Hingham	7½							200	
Coliasot	25							297½	
Scituate								5	
Duxbury									
Plymouth									
Harwichport								5	
Sandwich									
Barnstable					8	11	22½	89½	
Provincetown	162	170½	32½	87½	8½	37½	33½	1,537½	
Truro								152½	
Wellfleet	169½	158½	48	50½	10½	30	42½	1,402½	
Harwich	125	87½	64½	80½	89	109½	27½	2,038	
Chatham	88½	103	42	51	11	25	22	2,271½	
Dennis	116½	44½		5		25	21½	2,560½	
Yarmouth									
West Fisbury									
Swansey								230½	
Nantucket				104½	5	27½		215½	
Dartmouth	4	28½							
Total	868½	1,245½	307½	413½	267½	877½	265½		18,228*

* 10 barrels are marked No. 2.

61.—MARKETS.

Mr. Thompson remarks: "Previous to 1862 the market for fresh fish was limited to New Bedford, Fall River, Providence, and the adjoining towns, and a large proportion of the fish then taken was salted and shipped to the West Indies and the Southern States. This was especially the case with those taken about Noman's Land and Martha's Vineyard. Now nearly all are consumed fresh, and the average price is somewhat higher than formerly."

The Gloucester Telegraph of September 7, 1850, contained the following item, which shows that Sword-fish were eaten in Boston at least thirty years ago, and, highly esteemed:

"A Sword-fish weighing about 250 pounds was caught near our cape on Tuesday. It was taken to Boston and retailed out from Quincy Market, by Messrs. Covill, at 12½ cents per pound. The sword, measuring from the eye to the tip, is 37 inches in length."*

Mr. John H. Thomeon writes: "At present the great bulk of the catch is sold fresh. Most of the fish are brought to this port, and a few are carried to New London. Until within a *very* few years nearly all were disposed of in this vicinity. About 1864 a few were sent to Boston on trial, and the consumption of Sword-fish in that vicinity has since rapidly increased. Still, the principal market for fresh Sword-fish may be said to lie between New London and the eastern end of Massachusetts. Providence, R. I., consumes a large quantity."

Mr. Earll writes: "About 2,000 Sword-fish, averaging in weight 300 pounds dressed, have been landed yearly in Portland for several years. Most of them are sent to Boston fresh, and the remainder are cut up and salted here."

Mr. Eugene G. Blackford informs me that Sword-fish are not much esteemed in New York market, and that in 1874 not more than 2,000 pounds in the aggregate were consumed.

62.—PRICES.

Regarding the price of fresh fish at New Bedford, Mr. Thomson remarks: "When the first fish arrives here it is eagerly sought at 20 cents a pound, retail. In 1873, within forty-eight hours of the arrival of the first one, fifty-two were brought in, bringing the general retail price down to 8 and 10 cents. At this price, clear of bone, they are usually retailed throughout the season. The wholesale price is about 12 cents for the first catch, falling rapidly to 2 or 3 cents. This is for 'clean fish', without head, tail, and viscera. Fish from George's Bank are sometimes brought here from Boston. They then retail at 15 and 20 cents."

According to the record of the "Northern Eagle", the price in June,

* A Sword-fish weighing over 700 pounds was one of the sensations at Faneuil Hall Market last week.—*Gloucester Telegraph*, August 13, 1870.

1878, ranged from 2 to 4½ cents, in July from 3 to 5 cents, and in August from 2½ to 3.

In July, 1879, Mr. Earll found the price in Portland, Me., 4 cents, but the arrival of 200 fish on August 1 brought the price down to 1½ cents. He estimates the average wholesale price at 2 cents.

In New London, according to Captain Ashby, the price has varied within his recollection from 3 to 8 cents, the latter high price being paid in 1877.

According to Captain Martin, the price of salt Sword-fish in Gloucester is always about the same as that of No. 3 mackerel. In July, 1878, there being no mackerel in the market, they were valued at \$7 a barrel.

