A CONTRIBUTION TO THE SYSTEMATICS OF *SCOLIODON ACUTUS* (RÜPPELL), *HEMIPRISTIS ELONGATUS* (KLUNZINGER) AND *TORPEDO ZUGMAYERI* ENGELHART.

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(Plate XI)

INTRODUCTION.

In our studies on the systematics of Bombay elasmobranchs, we came across three species, *viz.*, *Scoliodon acutus* (Rüppell), *Hemipristis elongatus* (Klunzinger) and *Torpedo zugmayeri* Engelhart, existing accounts of which are far too meagre to permit of easy identification of the species. They are not well-known to icthyologists and none of them is of common occurrence in Bombay waters, *Hemipristis elongatus* (Klunzinger) being recorded here for the first time from the Indian seas. Detailed descriptions of these forms are therefore included in this paper and their systematic position is discussed.

All the forms are fully illustrated. All text-figures have been prepared by Babu R. Bagchi, Artist, Zoological Survey of India, Calcutta, from specimens supplied by the authors, who take this opportunity of thanking both Dr. S. L. Hora, Director, Zoological Survey of India and Babu R. Bagchi for their kind help and co-operation.

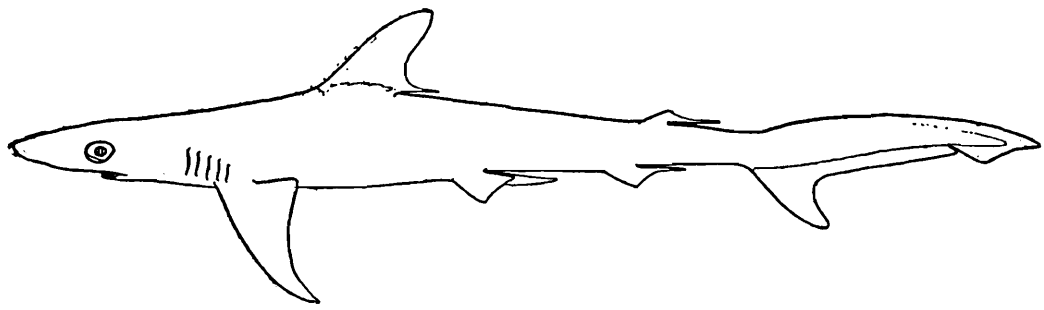
SYSTEMATIC ACCOUNT.

Scoliodon acutus (Rüppell).

1835. *Carcharias acutus*, Rüppell, *N. W. Fische*, p. 65, pl. xviii, fig. 4.
1841. *Carcharias acutus*, Müller and Henle, *Plagiost.*, p. 29.
1870. *Carcharias acutus*, Günther, *Cat. Fish. Brit. Mus.* VIII, p. 358.
1878. *Carcharias acutus*, Day, *Fish. India*, p. 712, pl. clxxxiv, fig. 3.
1946. *Scoliodon ceylonensis*, Setna and Sarangdhar, *Proc. Nat. Inst. Sci. Ind.* XII, pp. 246-252.

Four species of the genus *Scoliodon*, *viz.*, *S. sorrakowah* (Cuv.), *S. palasorrah* (Cuv.), *S. acutus* (Rüpp.) and *S. walbeehmi* Blkr. have, so far, been recorded from the Indian seas. Müller and Henle, Günther and Day accepted *S. acutus* as a distinct valid species, but later icthyologists like Garman [1] and Fowler [2] considered it as only a synonym of *S. palasorrah* (Cuv.). Careful scrutiny of our collection of these fishes from Bombay waters leads us to infer that *S. acutus* (Rüpp.) is a valid species. Its detailed description is given below and its affinities pointed out.

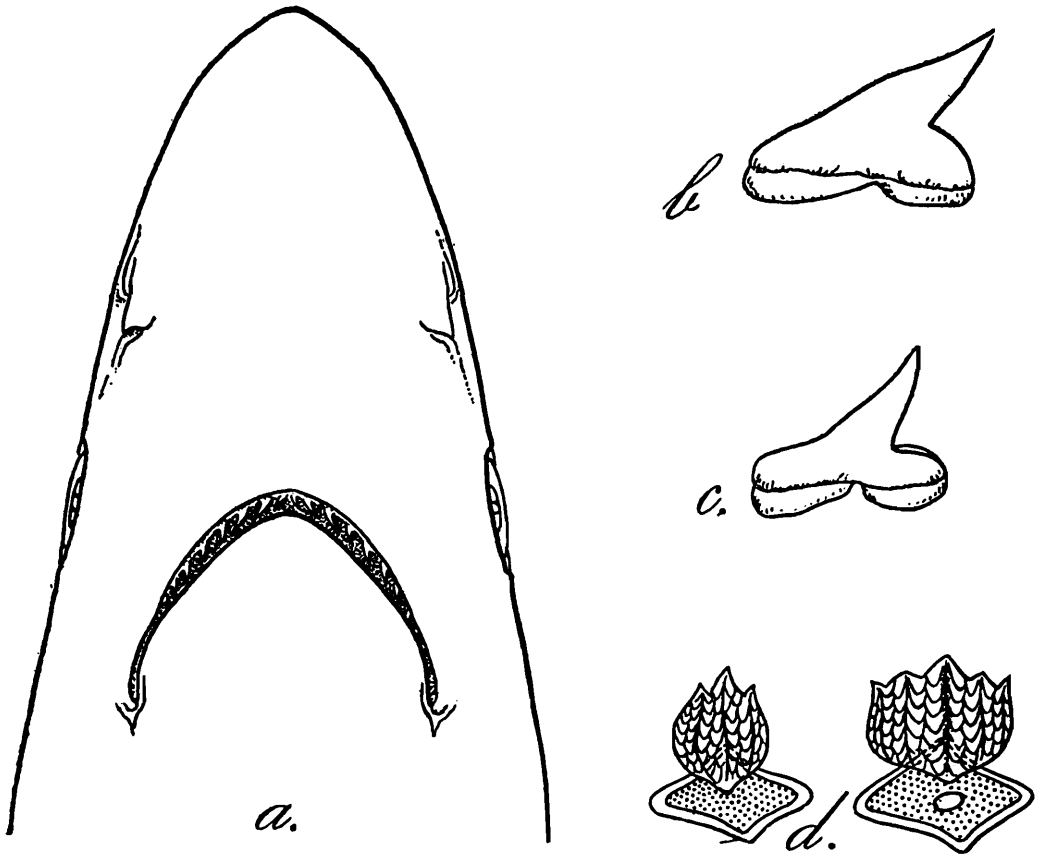
[1] Garman, S., *Mem. Mus. Comp. Zool. Harvard* XXXVI (1913).
[2] Fowler, H. W., *U. S. Nat. Mus. Bull.* (100) XIII (1941).



TEXT-FIG. 1.—Lateral view of *Scoliodon acutus* (Rüpp): $\times\frac{1}{7}$.

The snout is rather elongated and triangular in outline, with a broadly acute, but rounded, tip. The length of its preoral portion is one and a half times the width of the mouth at the angles and nearly equal to the distance between the eye and the first gill-opening. The nostrils, with small, triangular, flap-like, anterior valves, are nearer to the apex of the mouth than to the end of the snout. The grooves at the angles of the mouth are short and extend very slightly along the lower jaw only, but not on the upper (Text-fig. 2*a*).

Eyes are big, the iris being black with horizontally oval pupils. The gill-slits are about the size of the eyes.



TEXT-FIG. 2.—*Scoliodon acutus* (Rüpp).

a. Ventral surface of head: $\times\frac{4}{5}$; *b*. A tooth from upper jaw: $\times 6\frac{2}{5}$; *c*. tooth from lower jaw: $\times 6\frac{2}{5}$; *d*. Dermal denticles: $\times 6\frac{2}{5}$.

Teeth (Text-fig. 2*b*, *c*).—Dental formula : $\frac{12.1.12}{12.1.1.12} = \frac{25}{26}$. There is a small median tooth on the upper jaw, whereas the lower has two. The teeth on both jaws are obliquely situated, those on the upper being distinctly bigger than those on the lower. All the teeth are externally notched and have entire borders both on notches and cusps. Their bases are not swollen.

Dermal denticles (Text-fig. 2*d*).—The spines are mostly tricuspid and tricarinate, and higher than broad. Very often, the lateral cusps are not sharply marked off. They tend to converge towards the middle line, whenever they are present. Such a spine bears, in outline, resemblance to a typical ovate leaf. A pentacrenate and pentacarinate spine is rarely encountered. Such spine is broader than long. The basal plates are broad and quadrangular, with rounded angles.

Fins.—The pectoral fin originates below the second gill-slit. Its outer border is nearly thrice the length of its inner. Its hind border is obliquely concave, the outer angle of the fin extending well behind the inner. The former reaches just below the origin of the dorsal when applied to the sides of the body. The first dorsal fin is situated midway between the inner angles of the pectorals and origin of the pelvic fins. It is sickle-shaped, its hind border being deeply concave. It has a pointed tip extending posteriorly, but stopping well ahead of the pelvic origin.

The pelvic fins are rather small and located midway between the origin of the pectorals and the root of the caudal. The anal fin has a broad lower angle and a gently concave hind border not deeply excavated. Its free posterior tip is nearly as long as its base. The position of the anal fin in relation to the pelvic and caudal fins may thus be fixed. The distance between the posterior end of the anal base and the root of the caudal is two-thirds that between the posterior end of the pelvic base and the origin of the anal. The former distance is also only slightly greater than that between the posterior end of the base of the second dorsal and the root of the caudal fin.

The second dorsal fin originates above the posterior end of the anal base. The length of its base is about half that of the latter fin, and the fin itself is only two-thirds as high as the anal. Its upper angle is very obtuse, while its hind border is nearly straight and considerably elongated. This fin, too, has a pointed tip extending posteriorly. The caudal fin is about one-fourth the total length, with a gently convex upper border. The sub-caudal lobe is prominent and has an almost vertical posterior border. The posterior notch on the caudal blade is located at the junction of the middle and posterior third of the caudal blade.

Colour.—Grey above, dull white at sides and beneath. Fins grey with light edges.

Size.—Specimens measuring 600 mm. to 750 mm. in total length are landed during November and December.

Food.—Small fishes, such as 'Dhoma' (*Sciaena glauca*), 'Mandeli' (*Coilia dussumieri*), etc. and prawns, shrimps and cuttlefish are usually among the stomach contents.

Breeding habits.—Viviparous; three to four young ones, at least 300 mm. long are probably brought fourth at a time.

Distribution.—Red Sea, Seas of India to the Malay Archipelago and beyond.

Remarks.—*Scoliodon acutus* is closely allied to *Scoliodon palasorrah* in general body form, but the two can easily be distinguished by the following table of characters :—

Scoliodon acutus.	*Scoliodon palasorrah.*
i. Labial folds in the angles of mouth and slightly along the lower jaw.	i. Labial folds prominent along lower jaw and occasionally also along the upper for a short distance. (The latter character is conspicuously marked in juvenile forms.)
ii. D. F. $\frac{12.1.12}{12.1.1.12}=\frac{25}{26}$	ii. D. F. $\frac{11.1.11}{11.0.11}=\frac{23}{22}$
iii. Appendicula on the placental cords of embryos as flat out-pushings of the placental cord sheath.	iii. Appendicula as elongated, thread-like and much-branched structures.

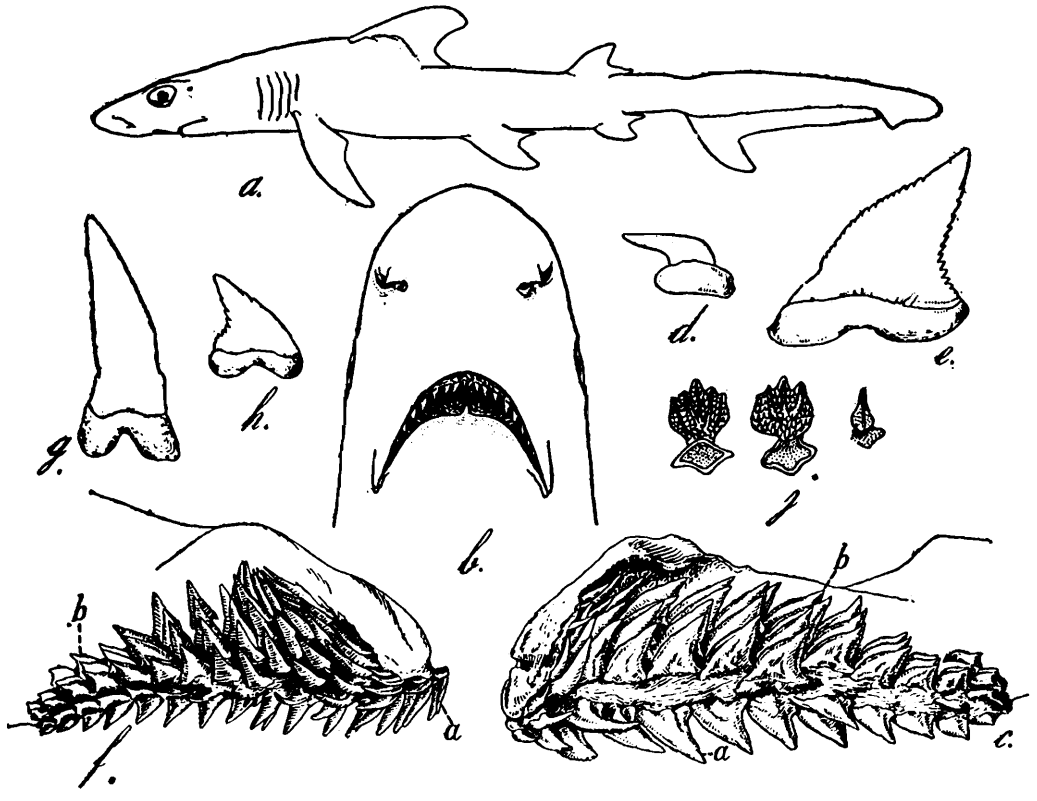
Hemipristis elongatus (Klunzinger).

(Plate XI, fig. 1.)

1871. *Dirrhizodon elongatus*, Klunzinger, *Verh. Zool-Bot. Ges. Wien.* XXI, p. 665.
1938. *Hemipristis elongatus*, Leriche, *Mem. Soc. Palae. Suisse* LXI, pp.11-18.
1941. *Hemipristis elongatus*, Fowler, *Bull. U. S. Nat. Mus.* (100) XIII, p.193.
1946. *Hemipristis pingali*, Setna and Sarangdhar, *Proc. Nat. Inst. Sci. India* XII, pp. 246, 253.

Local name.—Pingal or Datri.

The snout (Text-fig. 3*a*, *b*) is rounded and semi-circular in outline, its sides being nearly parallel. The length of its preoral portion is slightly greater than the width of the mouth in immature specimens, but distinctly less in adult individuals. Nostrils are situated midway between the apex of the mouth and the tip of the snout. Their anterior borders have medial, triangular, flap-like valves, while their posterior borders have slight grooves and folds medially (Text-fig. 3*b*). Prominent labial folds are present on both jaws, but those on the upper are about twice as long as those on the lower. Eyes are oval in outline, pupils roughly diamond-shaped and the iris is golden. Spiracles are very minute oval slits, situated behind the eyes at a distance of about half the orbital diameter. Gill-slits (Text-fig. 3*a*) are wide and about twice the size of orbits. The first four are of the same size, but the fifth is slightly smaller.



TEXT-FIG. 3.—*Hemipristis elongatus* (Klunzinger).

a. Lateral view: $\times\frac{1}{6}$; *b*. Ventral surface of head: $\times\frac{1}{3}$; *c*. Internal view of right ramus of upper jaw: $\times\frac{1}{2}$; *d*. A medial tooth on upper jaw: $\times 1\frac{1}{3}$; *e*. A lateral tooth on upper jaw: $\times 1\frac{1}{3}$; *f*. Internal view of right ramus of lower jaw: $\times\frac{1}{2}$; *g*. A medial tooth on lower jaw: $\times 1\frac{1}{3}$; *h*. A lateral tooth on lower jaw: $\times 1\frac{1}{3}$; *j*. Dermal denticles.

a. Teeth in use; *b*. Teeth in reserve.

Teeth.—D. F. $\frac{13\text{-}14.0.13\text{-}14}{15,\ 3.0.3,15} = \frac{26\text{-}28.}{36}$ The jaws are scantily covered by lips, and several rows of teeth project from them, strongly suggesting that several rows are in use at a time (Plate XI, fig. 1). The teeth on both jaws are distinctly dimorphic (Text-fig. 3*c*, *f*). There are no median symphyseal teeth on either jaw. The teeth on the upper jaw are all located on the outside (Text-fig. 3*c*). In one or two of the most medial rows, they are slender and pointed, awl-shaped and non-serrated (Text-fig. 3*d*). Teeth in the other rows are flat, triangular in outline and outwardly deflected, their outer margins being distinctly concave. Both the margins of these teeth are sharply serrated (Text-fig. 3*e*). (In young specimens, however, only the outer margins are prominently serrated, the serrations on the inner margins are less conspicuous and almost wanting in teeth of more medial rows). On the lower jaw three rows on either side of the symphysis are located on the inside (Text-fig. 3*f*). Altogether, six to eight rows on either side of the symphysis of this jaw are elongate, sub-cylindrical and claw-shaped, with non-serrated borders. Some of these teeth have, however, very minute serrations down on either side of the base (Text-fig. 3*g*). The teeth flatten out gradually in more lateral rows, become distinctly deflected outwardly and develop more serrations on their outer margins, so that these now become distinctly serrated (Text-fig. 3*h*). Rather inconspicuous serrations are also developed on their inner margins. The result is

that the teeth in the lateral rows of the lower jaw resemble those on the upper, though, of course, they are distinctly smaller. All the teeth have swollen, bifid bases. On either jaw a few teeth in the angles are very small.

Dermal denticles (Text-fig. 3*j*).—The spines are ovoid in form, being longer than broad. They are widest near the top third and narrow down basally. Some are trident with three keels, there being a rudimentary dent without a keel on either side of the lateral cusp. Other spines are pentacuspid with five cusps and five keels. The keels in either case do not, however, reach the base of the spine, but extend to only two-thirds its length. They are convergent basally. The cusps are either angular or squarish, the central cusp being the highest. The basal plates are small and rhombic in outline. In some scales, however, the spines are in a rudimentary condition, the cusps not being developed. The spines of such scales are spear-shaped in outline.

Fins.—A characteristic feature of the fins of this species that strikes the eye, is the deeply concave appearance of the hind borders. The pectoral fin originates behind the fourth gill-slit. It is falciform in outline, its posterior border being obliquely concave and its outer angle sharply pointed. Its medial border is nearly one-third its lateral and the fin extends well below the first dorsal. The latter fin originates above the inner angle of the pectoral. Its anterior margin is about one and a half times its base. Its hind border tapers posteriorly, but does not extend to the roots of the pelvics. The pelvic fins are fairly large with deeply concave posterior borders. The anal fin starts below the middle of the base of the second dorsal fin and is about half the size of the pelvic fins. It, too, has a deeply notched posterior border. The second dorsal fin originates in front of the anal and is about one and a half times the latter fin in size. The caudal fin has a well-developed subcaudal lobe and is obliquely notched posteriorly. It is contained about four times in the total length. The upper caudal pit is present as a marked depression, but the lower is not quite so conspicuous.

Colour.—Light ashy brown above, dull white at sides and below.

Size.—Maximum length recorded so far is 2·175 meters.

Food.—Prawns, Shrimps, Bombay ducks (*Harpodon nehereus*) 'Mandela' (*Coilia dussumieri*), 'Dhoma' (*Sciaena glauca*), smaller sharks (*Carcharinus limbatus*), Butterfly rays (*Pteroplatea poecilura*), 'Shingala' (*Arius* sp.), Mackerel (*Scomber microlepidotus*) etc., are usually among the stomach contents. The formidable nature of the teeth in this form justifies the havoc that it creates not only among the smaller fishes but also among such large fish as sharks and rays.

Breeding habits.—Viviparous; six to eight young ones probably about 450 mm. in total length at birth are brought forth at a time.

Distribution.—Bombay waters; Red Sea.

Remarks.—Only a single species of the genus *Hemipristis* is known to be living; *viz.*, *H. elongatus* (Klunzinger), and this has been described

from a single specimen collected by Klunzinger (1871) from the Red Sea. Unfortunately, Klunzinger's description is not quite lucid, nor did he illustrate the species.

The description of our specimens from the Bombay waters differs notably from that of Klunzinger in that the spiracles in our specimens are comparatively much smaller than the eyes and are also located nearer the eyes than in Klunzinger's specimen. Also, Klunzinger was not able to give the correct dental formula of the species, which has since been correctly described by Leriche (1938), who has also given a thorough account of the dentition in the species. Leriche has, however, described the most medial rows of teeth on either jaw as "Symphyseal" teeth. This term cannot, however, be said to be quite appropriate in view of the fact that these teeth are not located on the symphysis of the jaws, there being a pronounced toothless symphyseal space on either jaw.

The gestation and embryos of this singular species will be described by us in a subsequent publication.

Torpedo zugmayeri Engelhart.

(Plate XI, Figs. 2 and 3.)

1912. *Torpedo zugmayeri*, Engelhart, *Zool. Anz.* XXXIX, p. 647.

Two species of the genus *Torpedo*, *viz.*, *T marmorata* Risso and *T. zugmayeri* Engelhart have, so far, been recorded from the Indian seas. Fowler (1941) regards *T zugmayeri* as only a synonym for *T. marmorata*, remarking that the two species have been separated only on minor differences. Prashad,[1] however, ascertained after personal examination of a specimen of *T zugmayeri* in the Quetta Museum that the species is quite distinct from *T marmorata*.

The description of the specimens obtained by us agrees closely with that of *T. zugmayeri* Engelhart, although there are the following points of difference. The second dorsal fin in our specimens is from half to two-thirds the size of the first dorsal, whereas in *T zugmayeri* it is nearly three-fourths of that fin in size. Secondly, the distance between the outer margins of the eyes in our specimens is not equal to the distance between the eye and the body edge, whereas in *T. zugmayeri*, it is equal to the latter dimension.

The foregoing points of differences do not, however, appear to be sufficiently distinctive to justify the creation of a new species, and hence we are assigning the Bombay specimens to *T zugmayeri*. We are, however, describing the species in greater detail, as Engelhart's account of it is very brief, dealing mainly with features distinctive from those of *T marmorata* Risso.

The disc is subcircular. It is a little broader than long. The tail (the portion of the body behind the disc) is as long as, or slightly longer than, the disc. Starting at a point slightly ahead of the second dorsal origin, two skinny keels run along the sides of the tail to terminate on

[1] Prashad, B., *Rec. Ind. Mus.* XIX, pp. 98-99 (1920).

either side of the caudal fin a short distance behind its origin. The snout has a rounded anterior margin. Its length (in front of the interorbital line) is only slightly greater than the interorbital distance. The eyes are small and oval in outline. The iris is pale green and the pupil triangular, with its apex directed below. There is a very small superior protective flap.

Spiracles, which are more or less rounded in outline [1] are situated at least one orbital diameter behind the eyes and are from two to three times as large as they are. They have a slightly oblique axis. Each spiracular valve is a thick skinny fold beset posteriorly with eight very small papillae. The medial and posterior rims of the spiracles are studded with a single row of very small, conical warts. Nostrils are fairly prominent. The anterior nasal valves are confluent, forming a thick, broad quadrangular flap with a small median, backwardly directed, lobe-like projection. The latter merges behind into a median raphe, which is continued posteriorly into the upper lip. The anterior nasal flap does not cover the upper jaw. Each posterior nasal valve has a free, triangular, lobe-like section directed postero-laterally and an anterior section curving outwards and forwards in a half-loop to merge into the antero-lateral margin of the nostril. The mouth is small, gently arched and situated between two deep longitudinal folds. The teeth are arranged in pavement pattern. They are small, delicate and fragile, with sharp, slender cusps directed backwards. The dental plates do not extend along the entire length of the jaws, but are deficient laterally, They are small, nearly flat and without any angularities. Gill-openings are fairly big and semi-lunar in outline. The last pair is the smallest. The rows of gill-slit are more convergent posteriorly.

Fins.—More than half the base of the first dorsal fin is situated above the posterior extremity of the base of the pelvic. It is from one and half times to twice as large as the second dorsal, which is situated almost midway between the posterior end of the base of the first dorsal and the root of the caudal. The shape of the two dorsals is similar. The caudal fin is a single triangular flap with rounded angles, the lower angle being more rounded than the upper. The pelvic fins are large, with wide bases, convex outer borders and sharply pointed posterior tips. They arise slightly behind the posterior margin of the disc. Claspers are well developed, elongated, more or less cylindrical rods, with rather flattened, triangular posterior apices. They are swollen near their posterior ends. A well-defined, but tightly closed, longitudinal groove extends throughout the length of the dorsal surface of each clasper and there are two lateral open grooves extending along the posterior third of each.

Both the surfaces of the body are studded with minute flattened tubercles, these being especially concentrated along the margins of the disc and the lateral borders of the pelvic fins. Also, two rows of prominent skin pores are discernible ventrally near the lateral margins of the disc, commencing right from its anterior rim.

[1] Engelhart describes the spiracles as being semilunar in outline, stating that their cavities are compressed inwards by thick, fleshy pads. We find, however, that the semilunar character of the spiracles is not a permanent feature, in view of the contractile nature of the spiracular valves.

Colour.—The dorsal surface is brown, marked all over with numerous, thick, chocolate-brown streaks and narrow blotches intermingled in an irregular network. The undersurface is, for the most part, white, being bespeckled occasionally with purplish pigment. The ventral margins of the disc and those of the pelvic fins are dark, chocolate-brown. The under surface of the caudal penduncle, too, is of a chocolate-brown hue.

Size.—Specimens of this species occur but rarely in Bombay waters. The description given above pertains to a male specimen (Plate XI, fig. 3) obtained at Sassoon Dock, Bombay, in September, 1941. It had the following dimensions :—

Total length	343 mm.
Length of disc.	168 mm.
Length of tail	175 mm.
Width of disc	182 mm.
Length of clasper	42 mm.

A female specimen obtained by us from Worli, Bombay, on April 9, 1944, measured 287 mm. in total length (Plate XI, fig. 2). Its pelvic fins were comparatively much smaller in size and almost completely fused with the sides of the body, there being hardly any free projecting portions behind their wide bases. There were, also, no flattened tubercles on either surface of the body as noted in the male specimen described before. The specimen was immature, the ovaries not having yet developed. Both the oviducts were, however, present though in an undeveloped state.

Distribution.—Bombay waters ; Mekran Coast, Baluchistan.

EXPLANATION OF PLATE XI.

Elasmobranch fishes of Bombay.

Hemipristic elongatus (Klunzinger.)

FIG. 1.—Ventral surface of head in a female specimen measuring 2·175 meters in total length.

Torpedo zugmayeri Engelhart.

FIG. 2.—Photograph of a female specimen.

FIG. 3.—Photograph of a male specimen.