ovate, having the appearance of being laterally compressed, while in *C. mathewsi* it is compressed above and laterally dilated.

Alt. ·5, diam. maj. 1·5 mm.

Hab. Mount Pitt, Norfolk Island (*R. Bell*).

CRYPTOCHAROPA, gen. nov. (*Endodontidæ*).

Shell planulate, incrusted with an agglutinated mass of earth and vegetable matter, whieh broadens out at the periphery into a serrated fringe.

Genotype : *C. atlantoididea*, Preston.

The agglutinated covering which is present in every individual seen by the author, and which is extremely hard to remove even after several days of soaking, would seem to be a habitual generic character. The shell has a superficial resemblance to *Charopa*, though probably having no close relationship with that genus.

Cryptocharopa atlantoididea, sp. n.

Shell of moderate size, very depressedly orbicular, almost planulate above, covered with an agglutinated mass of foreign matter which broadens at the periphery into a coarse saw-like fringe or projection, and beneath which the shell is of a reddish-brown colour ; whorls 5, regularly increasing, the last strongly angled at the periphery, sculptured with coarse, irregular, somewhat radiate, transverse, and rather distant, wavy, spiral striæ, the latter becoming obsolete on the base of the shell ; suture deeply impressed ; umbilicus very wide ; columella margin excavatedly angled above, obliquely curved below ; labrum simple, receding below, projecting in front ; aperture subcircular.

Alt. 1·5, diam. maj. 3·75, diam. min. 3·25 mm.

Aperture : alt. 1·25 (nearly), diam. 1·25 (nearly) mm.

Hab. Mount Pitt, Norfolk Island (*R. Bell*).

The above measurements were taken after the agglutinated foreign matter had been removed from the shell.

Paralaoma orestias, sp. n.

Shell rather small, turbinate, somewhat shining, pale yellowish brown flecked with blotches of white ; whorls 5, the last subangulate at the periphery and descending in front, sculptured, especially on the lower whorls, with arcuate, slightly distant, transverse costulæ ; suture impressed ;

umbilicus moderately narrow, deep; columella margin outwardly reflexed, descending in a curve, diffused above it into a parietal callus which reaches to the upper margin of the labrum; labrum having the extreme edge submembranaceous; aperture ovate.

Alt. 1, diam. maj. 2·25, diam. min. 2 mm.

Hab. Mount Pitt, Norfolk Island (*R. Bell*).

Paralaoma perminuta, sp. n.

Shell minute, depressedly turbinate, thin, horny, pale brownish yellow; whorls 4, regularly increasing, sculptured with somewhat obsolete, transverse, arcuate plicæ; suture impressed; base of shell not very convex, sculptured with slightly wavy and closely set, punctate, revolving striæ; umbilicus moderately wide; columella margin obliquely descending; labrum simple; aperture compressedly sublunate.

Alt. ·25, diam. maj. 1·25 (nearly) mm.

Hab. Mount Pitt, Norfolk Island (*R. Bell*).

Paralaoma depressior, sp. n.

Shell allied to *P. perminuta*, but considerably larger and having an additional half whorl; the last whorl is considerably flattened above and strongly angled at the periphery, the colour is darker, being in the present species of a dark brownish-amber shade; the columella margin descends almost vertically and the aperture, though somewhat compressed towards the base, is obliquely subovate; the system of sculpture is altogether that of *P. perminuta*.

Alt. ·75, diam. maj. 2·25, diam. min. 2 (nearly) mm.

Hab. Mount Pitt, Norfolk Island, in several localities (*R. Bell*).

NORFOLCIOCONCHA, gen. nov. (*Endodontidæ*).

Shell minute, subhyaline, turbinate, with open umbilicus, sculptured with transverse riblets; aperture armed with two parietal lamellæ and two lamellæ on the outer wall.

Genotype: *Endodonta norfolkensis*, Hedley *.

Norfolcioconcha iota, sp. n.

Shell very minute, depressedly turbinate, in subfossil

* Rec. Austr. Mus., Sydney, vol. iii. p. 152, pl. xxviii. figs. 4, 5, 6.

condition white, vitreous, shining; whorls 4, regularly increasing, radiately finely costulate; suture impressed; base of shell sculptured with revolving striæ; umbilicus narrow, deep, well-like; columella margin obliquely descending; aperture somewhat compressedly sublunate, armed with four erect plaits, of which two are on the parietal wall, one below the other, and two on the outer wall, similarly situated.

Alt. ·25, diam. maj. 1 mm.

Hab. Limestone Quarry, S.E. coast of Norfolk Island, where it occurs in a subfossil state (*R. Bell*).

Succinea humerosa, sp. n.

Shell allied to *S. norfolkensis*, Sykes *, but differing from that species in being rather narrower in form and in having the last two whorls conspicuously *shouldered above and below*; the aperture is also rather longer and narrower than in *S. norfolkensis*.

Alt. 13·5, diam. maj. 8·5, diam. min. 5 mm.

Aperture: alt. 8, diam. 5 mm.

Hab. Nepean Island, in a subfossil state only.

Succinea nepeanensis, sp. n.

Shell elongate, whorls 3, rapidly increasing, moderately convex, the last very long; suture well impressed; columella margin curved, narrowly calloused; labrum simple, somewhat bent inwards over the aperture above; aperture ovate.

Alt. 14·75, diam. maj. 7·25, diam. min. 5·5 mm.

Aperture: alt. 9·25, diam. 5·75 mm.

Hab. Nepean Island, in a subfossil condition only (*R. Bell*).

Tornatellina norfolkensis, sp. n.

Shell subulately cylindrical, thin, fragile, semitransparent, smooth, polished, shining, pale reddish brown; whorls 6, the first very small, the second proportionately large, the remainder regularly increasing, marked only with irregular growth-plicæ; suture impressed, very narrowly margined below, columella whitish, developed into a rather twisted, inwardly projecting fold, and extending above into a light, well-defined, and somewhat restricted parietal callus, which reaches to the upper margin of the labrum; labrum simple; aperture inversely auriform, bearing a single, curved, erect, white, entering, parietal lamella.

Alt. 3·5, diam. maj. 1·25 mm.

Hab. Ball's Bay, Norfolk Island (*R. Bell*).

* Proc. Malac. Soc. London, iv. 1900, p. 144, pl. xiii. fig. 12.

Tornatellina norfolkensis moohuensis, subsp. n.

Shell differing from *T. norfolkensis*, Preston, in its very slightly shorter and *much broader* form, and in the parietal lamella, which, in the present species, is quite obsolete.

Alt. 3·5, diam. maj. 1·5 mm.

Hab. Moohu Stone, a small islet off the coast of Norfolk Island (*R. Bell*).

Tornatellina norfolkensis nepeanensis, subsp. n.

Shell allied to both *T. norfolkensis* and *T. moohuensis*, but differing from the former in its much broader form and from the latter in its more tapering spire, more rounded whorls, and well-developed parietal lamella.

Alt. 3·5, diam. maj. 1·5 mm.

Hab. Nepean Island (*R. Bell*).

With the exception of *Vallonia* sp., which is exceedingly plentiful, this and the following are the only living species of land-mollusca found upon the island.

Tornatellina duplicilamellata, sp. n.

Shell fusiformly ovate, polished, shining, yellowish brown; whorls 5, regularly but rather rapidly increasing, somewhat inflated, marked only with growth-striæ; suture impressed; columella margin white, twisted, bearing a short projecting lamella above, descending below in an almost vertical curve; aperture rather obliquely inversely auriform, furnished with a well-developed, entering, parietal lamella.

Alt. 2·25, diam. maj. 1·5 (nearly) mm.

Hab. Nepean Island (*R. Bell*).

Palaina norfolkensis, sp. n.

Shell moderately small, sinistral, fusiformly ovate; colour of type-specimen pale yellowish, but varying in individuals from pure white to yellowish and delicate flesh-colour; whorls 6, convex, the first two small, the third large in proportion, the remainder regularly increasing, the apical whorl quite smooth, the second showing signs of very oblique, obsolete, transverse ribbing, the third finely and rather closely costulate; the fourth and remainder beautifully sculptured with slightly distant and oblique, erect, transverse, blade-like costulæ, the interstices on all four last whorls sculptured with fine, closely set, wavy, spiral striæ; suture deeply impressed; umbilicus very narrow; labrum continuous, vitreous, showing under the microscope the concentric growth-markings, broadly expanded except in the parietal region, where it is considerably contracted, not reflexed, circumference ovate; aperture circular, set well to the left of the axis of the shell; operculum thin, corneous, yellowish white, paucispiral, with central raised nucleus.

Alt. 2·5, diam. maj. 1·25 mm.

Hab. Stockyard Creek, Norfolk Island (*R. Bell*).

Palaina belli, sp. n.

Shell small, sinistral, roughly ovate, dull white shading to pale flesh-colour, with reddish-brown apex; whorls 5, convex, the first two small, the third proportionately large, the remainder regularly increasing, the two apical whorls quite smooth, the remainder sculptured with closely set, wavy, spiral striæ which become considerably coarser on the last whorl, crossed by not very erect, rather oblique, transverse costulæ; suture deeply impressed; umbilicus narrow, deep; labrum continuous, outwardly expanded, sublaminiferous, circular; aperture large for the size of the shell, subcircular.

Alt. 3·5, diam. maj. 1·75 (nearly) mm.

Hab. Mount Pitt, Norfolk Island (*R. Bell*).

Differing from the preceding chiefly in its smaller size, it having one whorl less, in the more closely set and less erect and blade-like costulæ, coarser spiral striæ, the circular circumference of the labrum, and in the comparatively large size and more central position of the aperture with regard to the axis of the shell.

LXVI.—*Five new Siphonaptera from Asiatic Russia, collected by W. Rückbeil.* By the Hon. N. Charles Rothschild, M.A.

[Plates XIV. & XV.]

One of the two species described below belongs to the genus which we call *Ctenophthalmus*, Kolen. We dealt with this generic name at some length in Nov. Zool. 1911, p. 80, and came to the conclusion that its type is a species with three genal spines. A. C. Oudemans, in a recent note on Siphonaptera (Entom. Berichten, 1913, p. 341), maintains, on the contrary, that *musculi* is the type. He says:—" The genus *Ctenophthalmus* is well defined by Kolenati by the words 'hat vor den Ocellen kleine bewegliche Ctenidien.'" The only European species of flea, Oudemans continues, which conforms to this definition is *musculi*, Dugès. Oudemans, it will be noticed, identifies (without further consideration) the "movable ctenidia" mentioned by Kolenati with the spine-like frontal bristles found in *musculi* and allies, *i. e.* in the genus which we call *Leptopsylla*. These frontal bristles, however, are by no means the ctenidia of Kolenati's description of *Ctenophthalmus*. The list of species which Kolenati gives as belonging to *Ctenophthalmus* proves that the "movable ctenidia in front of the ocelli" are nothing else but the genal ctenidia, which are present in all the species Kolenati mentions, while the frontal spiniform bristles are found only in the one species to which he refers as *talpæ*. Moreover, the whole context shows clearly that *Ctenophthalmus* was meant to comprise all the species with pronotal and genal combs. It was, in fact, a composite genus with a very general definition, and without any fixation of a type. We go even further, maintaining that Kolenati did not know of the existence of the spiniform frontal bristles of *musculi*, Dugès. He does not mention them anywhere, nor are they indicated in the figure which he gives of *musculi* (1863). We consider, therefore, Oudemans' action as being based on an erroneous premise, and shall continue to use, as did Kolenati in his later papers, the name *Ctenophthalmus* for *bisoctodentatus* and allies.

It may be mentioned in passing that Oudemans is also in error when stating that *musculi* is the only European species with "movable ctenidia in front of the eyes" in Oudemans' sense. There are several such species in Europe, one of which (*bidentatus*, Kolen., = *monoctenus*, Kolen., = *sobrinus*, Roths.) was already known to Kolenati besides *musculi*.

1. *Ctenophthalmus dolichus*, sp. n.
(Pl. XIV. figs. 1, 2.)

♂ ♀.—A near ally of *Ct. caucasica*, Tasch. (1880), but at once distinguished by the longer bristles of the hind tarsus and by the modified abdominal segments.

The pronotal comb contains fourteen spines. The longest apical bristle of the hind tibia extends to the apex of the first tarsal segment or beyond, the corresponding bristle of this segment reaching to the apex of the second segment, and the second segment has three apical bristles extending beyond the apex of the fourth. Several of the other bristles of the hind tibia and hind tarsus also are longer than in *Ct. caucasica.*

The clasper (Cl) of the ♂ (fig. 1) is produced distally into a very long and straight process, P^2, which is longer than in any of the allied species. The dorsal apical angle of the clasper is rounded (P^1) and bears three long bristles and several small ones. The movable exopodite F is as large as in *Ct. caucasica.* Its ventral margin is distally somewhat concave. The ninth sternite (IX.st.) is less obtuse and bears more bristles than in *Ct. caucasica.* The seventh sternite of the ♀ (Pl. XIV. fig. 2, VII.st.) is bisinuate, the lower sinus being very shallow. The apex of the segment is divided by these excisions into three lobes, the ventral lobe hardly at all projecting, the second one being broad, short, and strongly rounded, and the third much narrower and longer than the second. The ventral row of bristles of the eighth sternite (VIII.st.) ends with one short stout bristle.

A small series of both sexes from near Djarkent, Semitchenskoi, East Turkestan, November 25th and December 5th, 1912, off *Meriones tamaricinus.*

2. *Neopsylla teratura,* sp. n. (Pl. XIV. fig. 3.)

♂ ♀.—A very near relative of *N. bidentatiformis,* Wagn. (1893). The pronotum, in the ♂, bears on each side only 1 or 2 bristles in front of the postmedian row, and in the ♀ 4 or 5, instead of a more or less complete second row.

The eighth sternite of the ♂ has an apical brush of bristles, the long bristles being of nearly even width from the base to near the apex. The clasper (Cl) closely resembles that of *N. bidentatiformis,* but the process P^2 (fig. 3), as well as the movable process F, are narrower. The ninth sternite (IX.st.) has a very characteristic armature. The horizontal arm bears distally two rows of stout, short, spine-like bristles. One row is ventral and placed on the outer side, the other being situated along the centre of the inner surface. The ventral spines are strongly curved inwards and backwards, particularly the proximal ones. In *bidentatiformis,* of which Professor Wagner has kindly given us a ♂, there is only one row of spines, placed at the ventral margin, the spines being almost straight (fig. 4). The manubrium (M) of *teratura* is straight, with the extreme tip turned upwards. In the ♀ the apical margin of the seventh sternite is very slightly incurved, with the upper angle distinct but rounded. The eighth tergite bears a submarginal row of 8 bristles, the row being sometimes continued proximally by some small bristles. Proximally to the row there are 7 to 12 bristles, and on the inner surface at and near the margin 9 to 12.

1 ♂ and 2 ♀ ♀ from near Djarkent, Semitchenskoi, East Turkestan, February 11th and 19th, 1912, off a white weasel and *Meriones tamaricinus*.

I am not convinced that Wagner was correct in sinking his *setosa* as a synonym of *bidentatiformis* (*cf.* Horæ Soc. Ent. Ross. vol. xxxvi. p. 143, 1902). The original specimens of *bidentatiformis*, Wagn. (1893), were found by Wagner in the Crimea on *Epimys decumanus*, the above-mentioned ♂ being one of these specimens. This example bears on the pronotum on each side a postmedian row of 8 long bristles, in front of this row another of 8 smaller ones, and dorsally some additional small bristles representing a third row. We figure the ninth sternite of this true *bidentatiformis* (fig. 4). A ♀, also received from Professor Wagner, obtained in the Northern Caucasus off *Spermophilus*, and identified by him as the same species, has a shorter pronotum, which, moreover, bears only one row of bristles, the second (anterior) row being only represented by a few pale dots, which are presumably the grooves of insertion of small hairs. The individual otherwise agrees fairly well with the ♀ ♀ described above as *teratura*. As Wagner states of *bidentatiformis*, as well as *setosa*, that the pronotum has only one row of bristles (6 on each side), and as the specimens subsequently identified by him as *bidentatiformis* came from different countries and hosts, a re-examination of the types appears advisable. Possibly *setosa* is the same as *teratura*.

In Proc. Zool. Soc. Lond. 1911, p. 387, we described as *Neopsylla compar* another species closely allied to *N. bidentatiformis*. In this species, however, the small hairs found in *bidentatiformis* and *teratura* on the inner surface of the hind coxa are, partly, replaced by short spines. The ♀ ♀ of *teratura* and *compar*, as well as the above-mentioned ♀ received from Wagner as *bidentatiformis*, do not exhibit any very striking differences in the seventh and eighth abdominal segments and the receptaculum seminis (*cf.* Proc. Zool. Soc. Lond. 1911, p. 387, text-fig. 120).

3. *Ceratophyllus curvispinus*, Miyaj. (1912).

Paradoxopsyllus curvispinus, Miyajima, ubi ?
Ceratophyllus subcæcatus, Rothschild, in Clark and Sowerby, Through Shen-Kan, p. 194, no. 1, text-figs. 1, 2 (1912).

The author of *curvispinus* has very kindly sent several examples of this species, which proves to be the same as my *subcæcatus.* The description of *subcæcatus* was already printed when the specimens of *curvispinus* arrived, but the book in which the description appeared was only issued in the second half of 1912.

Although *curvispinus* is very remarkable on account of the peculiar development of the ninth abdominal sternite of the ♂, the species fits very well into *Ceratophyllus* as at present composed. If the genus *Ceratophyllus*, however, should require dividing up into a number of separate genera, *Paradoxopsyllus* will probably be one of them.

The two following species are so similar to *curvispinus* that a lengthy description is not necessary :—

4. *Ceratophyllus teretifrons*, sp. n. (Pl. XV. fig. 5.)

♂ ♀.—The frons has no tubercle in either sex, whereas a distinct frontal tubercle is present in both *curvispinus* and in the new species described under no. 5. There are two rows of bristles on the frons, the anterior row containing in the ♂ 5 or 6 and in the ♀ 4 or 5 bristles, the second row 3 large bristles in both ♂ and ♀. The occiput bears 2 or 3 bristles above the centre of the antennal groove, and in the ♂ 10 or more small hairs along the antennal groove. The long apical dorsal and ventral bristles of the hind tibia reach to the apex of the first tarsal segment, and the second segment has in both sexes two apical bristles extending beyond the fourth segment, these bristles being particularly long in the ♂. In the ♂ of *curvispinus* a subapical dorsal bristle of the second hind-tarsal segment also is much prolonged, which is not the case in *C. teretifrons.* The first mid-tarsal segment is at least one-eighth longer than the second.

In the ♂ of *teretifrons* (fig. 5) the eighth abdominal tergite only bears four long bristles, there being no patch of bristles on the sides, and the eighth sternite has on each side 3 or 4 bristles. The apical process P of the clasper is triangular, not truncate. The movable process F is longer than in *curvispinus*, its longest bristle being placed nearer the apex and its posterior edge bearing 6 to 8 thin hairs. The ninth sternite has the same peculiar shape as in *curvispinus*, but its ventral arm differs in being less abruptly widened in the centre and having here two slender bristles proximally to the two long ones, instead of their being short and spiniform. The apical hook of the penis is shorter and less slender than in *curvispinus.*

The modified abdominal segments of the ♀ do not present any reliable difference from the allied species, the outline and bristles of the eighth tergite being individually variable.

A series of both sexes from near Djarkent, Semitchenskoi, East Turkestan, October 15th and November 15th, 1912, off *Meriones tamaricinus*.

5. *Ceratophyllus repandus*, sp. n. (Pl. XV. figs. 6, 9.)

♂ ♀.—The frons has in both sexes a distinct tubercle. The bristles of the head and legs are similar to those of *C. teretifrons*, but the anterior row of the frons contains one or two bristles less.

The clasper resembles that of *teretifrons*, but the finger is a little shorter and bears fewer bristles at the posterior margin, the interspace between the longest bristle and the next below it being wider than in *teretifrons*. The widened central portion of the ventral arm of the ninth sternite (fig. 6) is more gradually dilated, and the bristles it bears are much less prolonged. There are in this place four bristles, the first being the shortest and thinnest and the other gradually increasing in length. The ventral angle of the dilated apex of this segment is rounded, and not triangular as in the two preceding species, and the apical hook of the penis is much broader, shorter, and more obtuse than in *curvispinus* and *teretifrons*.

The seventh and eighth abdominal segments of the ♀ (fig. 9) are apparently indistinguishable from those of *teretifrons*. The stylet, however, is half as long again in *teretifrons* as in *repandus*, being in *teretifrons* as long as the fourth hind-tarsal segment.

A series of both sexes from near Djarkent, Semitchenskoi, East Turkestan, October 5th, 1912, off *Meriones tamaricinus*.

6. *Ceratophyllus consors*, sp. n. (Pl. XV. figs. 7, 8.)

♂ ♀.—A near ally of *C. henleyi*, Roths. (1904), and *maurus*, Jord. & Roths. (1912), the apical bristles of the hind-tarsal segments being long and the dorsal ones of the meso- and metanota and proximal abdominal tergites forming in the ♂ a kind of mane. Two of the apical bristles of the second segment of the hind tarsus extend considerably beyond the apex of the fourth segment, being somewhat longer than in *henleyi* and *maurus*. *C. consors*, however, is more easily differentiated by the modified abdominal segments.

In the ♂ the eighth abdominal tergite (Pl. XV. fig. 7, VIII.t.) bears many more bristles than in the allied species, and is also more strongly produced posteriorly. In the clasper and its two processes, P and F, *C. consors* agrees rather closely with *C. henleyi*; but P is broader in *consors*, and the proximal edge of F is not angulate. The ninth sternite (IX.st.), however, is decidedly narrower distally than in *C. henleyi*. The seventh sternite of the ♀ (Pl. XV. fig. 8) is obliquely sinuate, the lobe below the sinus being much produced and rounded, except ventrally, while the lobe above the sinus is usually narrow and pointed. This upper lobe varies greatly in length, being sometimes very short and rounded.

A long series of both sexes from Djarkent, Semitchenskoi, East Turkestan, October 15th, 1912, off *Meriones tamaricinus*.

EXPLANATION OF THE PLATES.

Plate XIV.

Fig. 1. Clasping-organs of ♂ of *Ctenophthalmus dolichus*, sp. n. Cl, clasper; P^1 and P^2, upper and lower processes of same; F, movable process; VIII.st. and IX.st., eighth and ninth sternites.
Fig. 2. Seventh and eighth abdominal segments of ♀ of *Ctenophthalmus dolichus.*
Fig. 3. Clasping-organs of ♂ of *Neopsylla teratura*, sp. n.
Fig. 4. Ventral arm of ninth sternite of ♂ of *Neopsylla bidentatiformis*, Wagn. (1893).

Plate XV.

Fig. 5. Clasping-organs of ♂ of *Ceratophyllus teretifrons*, sp. n
Fig. 6. Ninth sternite and apex of penis of ♂ of *Ceratophyllus repandus*, sp. n.
Fig. 7. Clasping-organs of ♂ of *Ceratophyllus consors*, sp. n.
Fig. 8. Seventh and eighth abdominal segments of ♀ of *Ceratophyllus consors*, sp. n.
Fig. 9. Seventh and eighth abdominal segments of ♀ of *Ceratophyllus repandus*, sp. n.

LXVII.—*Notes on the South-American Freshwater Flying-fish,* Gastropelecus, *and the common Flying-fish,* Exocœtus. By W. G. Ridewood.

[Plate XVI.]

Although less popularly known than the common flying-fish, *Exocœtus*, the flying gurnard, *Dactylopterus*, and the African freshwater flying-fish, *Pantodon*, the freshwater flying-fish of Guiana, *Gastropelecus*, may ultimately prove to have a better claim to the title "flying-fish" than the others, for there is no doubt in their case that the pectoral fins are flapped vigorously during the passage of the fish through the air. The various species of *Gastropelecus* possess a deep, laterally compressed body, with fairly long and curved, but not remarkably large, pectoral fins. The length of the fish is some 3 inches or less. The habits of these fishes are alluded to in Mr. and Mrs. Beebe's book 'Our Search for a Wilderness' (London, 1910), and the species and their habits are described by C. H. Eigenmann ("Freshwater Fishes of British Guiana," Memoirs of the Carnegie Museum, v., Pittsburg, 1912, p. 47). The fishes are said to dart forward for a distance of 40 feet or more, beating the water with their pectoral fins, the upper part of the body alone being exposed, and the sharp keel of the breast acting as a cut-water. They then leave the water entirely for a distance of 5 or 10 feet, and, when exhausted, fall sideways into the water again.

Removal of the skin from the front half of the body displays the great pectoral muscle, which is one of the most striking features of the fish. This muscle is in the form of a thick sheet, thinning off at the front and lower edges. The muscle-fibres radiate in an upward direction from the front and lower edges to the base of the pectoral fin, to the underside of the fin-rays of which their tendinous extremities are attached. This great muscle, by its contraction, draws down the fin. The elevator muscles of the fin are small, no larger than would be the case in an ordinary fish of the same size.

The great external pectoral muscle arises from the whole of the side of a large keel or plate of bone lying in the median plane of the body; the plate is corrugated in a radiating manner, like a half-opened fan (see Plate XVI.), the radiating ridges of one side corresponding with the radiating grooves of the other side. This corrugation of the lamina of bone affords greater strength, and offers a larger surface for the attachment of the muscle, than would be the case if it were flat. The front edge of the keel reaches the surface of the body, and is covered by thin skin only; it forms the edge of the "cut-water." The pectoral girdle of *Gastropelecus* has already been figured by C. T. Regan (Ann. & Mag. Nat. Hist. (8) viii., July 1911, p. 19), but when dissociated from the rest of the skeleton its relatively great size is not apparent (see Plate XVI.).

The great keel is composed of the coalesced right and left coracoid (hypocoracoid) bones; the upper front point of it is connected by ligament with the anterior ends of the clavicles. The nearest allies to *Gastropelecus* are most probably the species of *Tetragonopterus,* of the family Characidæ. In *Tetragonopterus*, however, there is nothing unusual about the pectoral girdle ; the downwardly directed plates of the coracoids extend in close contact with one another for some little distance, as in many other Characidæ (e. g., *Chalcinus trachypomus* ; see Regan, Ann. & Mag. Nat. Hist. (8) viii. p. 19, fig. 1, B), but the plates are not fused into a single median lamina, and they exhibit no radiating grooves and ridges.

More remarkable than the great size of the bony keel of the pectoral girdle of *Gastropelecus* is the high proportion which the weight of the muscles attached to the keel bears to the total weight of the body. Put roughly, the right and left external pectoral muscles together constitute one-fourth of the weight of the fish, whereas in the allied but unmodified form *Tetragonopterus* the proportion is 1 to 140. The details of the computation are as follows :—The weight of a specimen of *Gastropelecus stellatus,* taken from spirit and lightly wiped with a cloth, was 6·50 grammes ; the weight of the right and left external pectoral muscles dissected off was 1·59 grammes. The proportion of the latter to the former is 1 to 4·088. In the case of a specimen of *Tetragonopterus æneus,* selected as nearly as possible of the same size as the specimen of *Gastropelecus,* the total weight of the body was 7·01 grammes, the weight of the right and left external pectoral muscles was ·050 gramme ; the proportion of the latter to the former is thus 1 to 140·2.

So remarkable is this difference in the relative size of the depressor muscle of the pectoral fin in *Gastropelecus* and *Tetragonopterus*, that it seemed advisable to compare by the same method the depressor muscles of the common flying-fish, *Exocœtus*, with those of its nearest relatives, *e. g.* the skippers, of the genus *Hemirhamphus,* for which no one has claimed the capacity for flight. The figures given by C. D. Durnford (Ann. & Mag. Nat. Hist. (7) xviii., Nov. 1906, p. 337) are computed from the depth to which a pin reaches when inserted into the muscle at certain points, and not by weighing the muscle dissected from the body.

There is nothing in the appearance of the bones of the pectoral girdle of *Exocœtus* and *Hemirhamphus* to suggest that the muscles are vastly greater in the former than in the latter ; the proportions of the parts are much the same in both, and there is not in either case a great keel or median lamina of bone for the attachment of the depressor muscles.

For the purpose of this comparison spirit-preserved specimens of *Exocœtus evolans* and *Hemirhamphus roberti* were taken, of as nearly the same size as was possible. *Hemirhamphus* is a more slender fish than *Exocœtus*, the lower lobe of its caudal fin is only slightly larger than the upper lobe, and the lower jaw is greatly produced beyond the upper jaw. For comparing the lengths of the two fishes, therefore, it is better to disregard the lower jaw and the tail-fin, and to measure from the front of the upper jaw to the end of the scaly part of the base of the tail. This measurement in the case of *Exocœtus* was 151 mm.; in *Hemirhamphus* it was 185 mm. The length of the pectoral fin lying closed against the side of the body was 106 mm. in *Exocœtus*; in *Hemirhamphus* it was 23 mm. The girth of the middle part of the body was 81 mm. in *Exocœtus* and 71 mm. in *Hemirhamphus*. In the case of *Exocœtus* the weight of the body was 46·5 grammes, the weight of the right and left external pectoral muscles ·78 gramme, and the proportion yielded was 1 to 59·61. In the case of *Hemirhamphus* the body-weight was 39·0 grammes, the weight of the external pectoral muscles ·32 gramme, and the proportion was 1 to 121·87. Or, putting it the other way, the body-weight in each case being unity, the pectoral muscle-weight is ·0167 of the body-weight in *Exocœtus* and ·0082 in *Hemirhamphus*. In other words, the muscles are twice as large in *Exocœtus* as in a *Hemirhamphus* of about the same size.

That the pectoral fins of *Exocœtus* are larger than in most fishes of the same size is admitted by all, even by those who contend that the fish does not fly, *i. e.* flap its fins, but merely uses the fins for gliding or "planing" when once the vigorous lashing of the tail has jerked the body obliquely into the air. With an enlargement of the fin-area one would naturally expect an enlargement of the muscles that operate the fins. The point to be solved is whether the muscles have been enlarged in the same proportion as the fin-area, or whether they have been enlarged in a much greater proportion, as would be necessary if the fish is to flap the fins so vigorously as to maintain the body in the air, as is claimed by the adherents of the "flying" hypothesis.

For the determination of this point the left pectoral fin of each fish was spread out on a sheet of paper, a pencil line was drawn around the edge, and the paper was then cut along the pencil line. A strip of the same sheet of paper was cut 1 centimetre wide, and this strip was shortened successively until it weighed the same as the piece of paper representing the fin. The length of the strip of paper in centimetres gives, with approximate accuracy, the size of the fin-surface in square centimetres. The sizes so obtained are probably too small, for it is not possible to spread out to its fullest extent the fin of a fish that has been preserved in alcohol. The surface of the two pectoral fins of *Exocœtus* as thus computed was 38·4 square centimetres, whereas the corresponding area in the case of *Hemirhamphus* was 3·9 square centimetres. That is to say, the superficial area of the pectoral fins of *Exocœtus* is some eight or nine times that of the corresponding surface in a *Hemirhamphus* of the same size, whereas the weight of the external pectoral muscles is only twice.

As an item of negative evidence, it may be of interest to state that a microscopical examination was made of dissociated fibres of the external pectoral muscles of *Gastropelecus stellatus, Tetragonopterus æneus, Exocœtus evolans,* and *Hemirhamphus roberti,* in order to ascertain if in the "flying" form the cross-striping of the muscle-fibres was more pronounced than in the control species. The fibres, after being teased, were stained, some with picric-acid-fuchsin (van Gieson's stain), some with borax-carmine; some were examined in diluted glycerine, some in Canada balsam. Examination of these slides failed to show any marked differences in the degree of cross-striping.

In conclusion, I have to thank Dr. S. F. Harmer, F.R.S., Keeper of the Department of Zoology in the British Museum, and Mr. C. Tate Regan, M.A., Assistant in charge of the Fishes, for providing me with the specimens upon which the observations recorded above were made.

EXPLANATION OF PLATE XVI.

Photograph of a skeleton of *Gastropelecus stellatus* (× $\frac{4}{1}$). Note the great radially corrugated keel of bone, to the right and left sides of which are attached the external pectoral muscles, which pull down the fins.

LXVIII.—Phallostethus dunckeri, *a remarkable new Cyprinodont Fish from Johore.* By C. Tate Regan, M.A.

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In 1904 (Mitteil. Naturhistorisch. Mus. Hamburg, xxi. pp. 135–207) Dr. G. Duncker published a memoir on the Fishes of the Malay Peninsula, and on page 171 mentioned a new Cyprinodont in the following words:—"Die beschreibung zweier weiterer, einer neuen Gattung mit gekieltem Abdomen, hinter der A. befindlicher D., gegabelter C. und fehlenden V. angehörigen Arten dieser Familie behalte Ich für später vor. Beide gehören dem Brackwasser an (Kuala Langat, Muar-Flusz bei Bandar Maharani)."

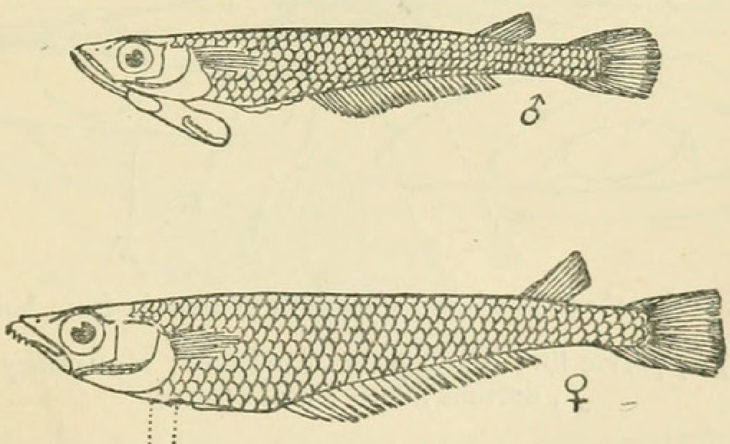
A few months ago Dr. Duncker visited the British Museum to study our Syngnathidæ, and I then asked him whether he had published anything further concerning these fishes, whereon he kindly offered to send me some of them for description, as he was engaged in other work.

The specimens prove to belong to a new genus and species, which is so different from other known Cyprinodonts that it should perhaps rank as the type of a separate subfamily.

PHALLOSTETHUS, gen. nov.

Form elongate, compressed; scales moderate; vent thoracic. Mouth protractile, oblique, with the horseshoe-shaped lower jaw included within the shovel-shaped upper one; teeth conical, biserial; outer series of upper jaw curved, rather strong, especially the anterior lateral ones; outer series of lower jaw nearly horizontal. Dorsal fin short,

Fig. 1.



Phallostethus dunckeri, male and female, a little more than twice natural size.

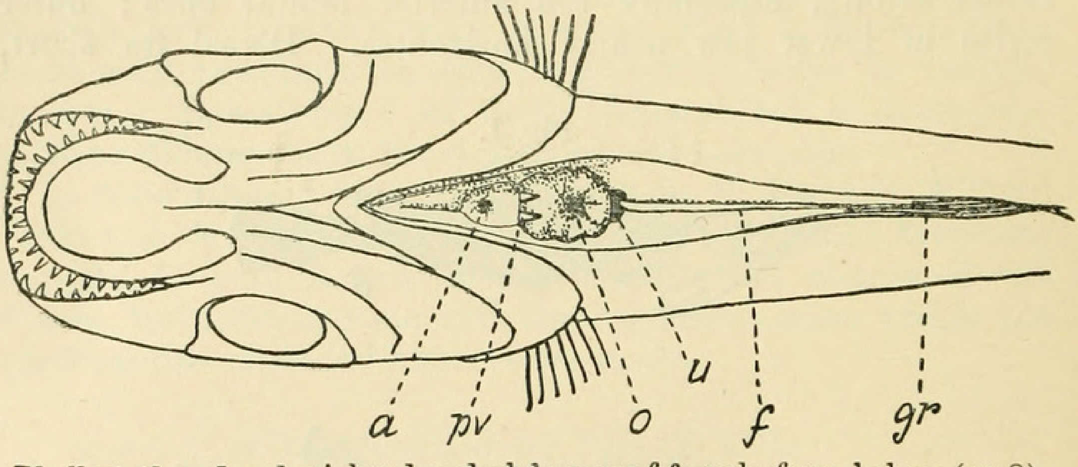
originating above end of the long anal; in front of the latter a median dermal fold placed in a groove. Female with pelvic fins minute, below the pectorals, between vent and opening of oviduct. Male with a large muscular appendage attached between the expanded hypocoracoids and free distally, bearing the vent on one side at about the middle of its length and the genital opening at its posterior end, just behind the articulation of an external movable, forwardly directed, serrated bone ; anteriorly the appendage ends in a long slender bone extending forwards to beneath the chin, curved towards the side on which the serrated bone lies and away from that on which the vent opens.

Phallostethus dunckeri, sp. n.

The form and proportions are shown by the accompanying figures. I count 8 to 10 dorsal and 26 to 28 anal rays; the caudal fin is imperfect in all, so that its exact shape is uncertain ; there are about 40 scales in a longitudinal series, and they appear to correspond to the myotomes, so that the vertebræ number about 40. Of seven specimens (three males and four females) the largest male measures 25 mm., the largest female 29 mm. in total length.

The external features of the lower surface of the head and abdomen in the female fish are illustrated in fig. 2. A flattish

Fig. 2.



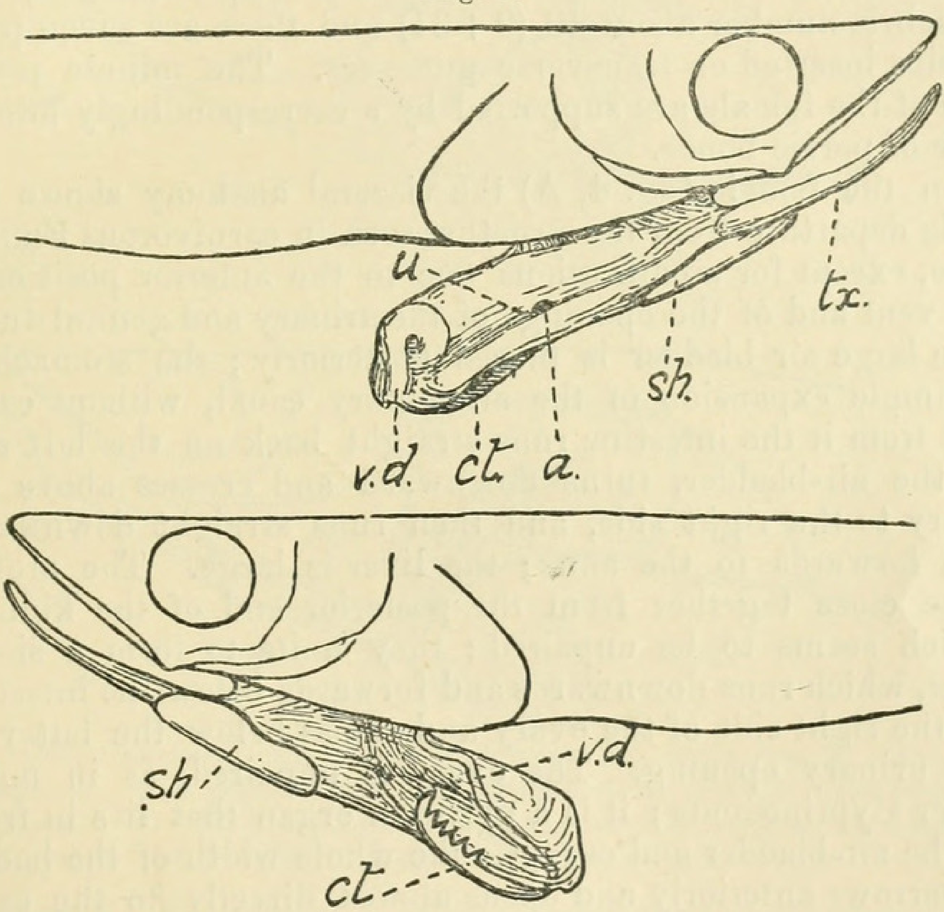
Phallostethus dunckeri, head and abdomen of female from below (× 8).

a., anus; *pv.*, pelvic fin ; *o.*, opening of oviduct; *u.*, urinary opening ; *f.*, dermal fringe ; *gr.*, groove.

median naked area margined anteriorly by the lower edges of the hypocoracoids expands backwards and contains sucessively the vent, a pair of almost vestigial pelvic fins, the genital and urinary apertures ; from the last a low median keel runs backwards. Behind the opening of the oviduct the naked area contracts, and it becomes a groove, which extends to the origin of the anal fin, becoming narrower and deeper posteriorly ; the walls of the groove are supported by the ends of the seven pairs of ribs.

The male (fig. 3) differs from the female externally in that the median keel is more developed as a membranous fringe and in front of it the very deep groove extends forwards, being margined anteriorly by the strongly expanded hypocoracoids, from between which there projects downwards and backwards a large fleshy appendage, oblong in form and laterally compressed, which may be termed the *priapium*; at the posterior end of this can be seen the opening of the vas deferens, and at about the middle of its length, on one side, hereafter termed the "proctal" side, the vent, directly behind which is the urinary opening. At the anterior end is a long and

Fig. 3.



Phallostethus dunckeri, male, showing external features of the priapium from the proctal and the aproctal side (× 8).

tx., toxactinium; *ct.*, ctenactinium; *sh.*, shield of thick skin; *v.d.*, vas deferens; *a.*, anus; *u.*, opening of ureter. The two last lie in a slight groove which indicates the boundary between the dorsal and ventral muscles.

slender bony spine, rounded in cross-section, tapering forward beneath the chin, and curved away from the proctal side; this rod may be termed the *toxactinium*; it can be moved