PELECYPODA OF THE INDAWGYI LAKE AND OF ITS CONNECTED FRESHWATER AREAS IN THE MYITKYINA DISTRICT, UPPER BURMA.

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(Plate VIII.)

The Gastropod molluscs of the collections made by Dr. B. Chopra of the Zoological Survey of India in the cold weather of 1926 in the Indawgyi Lake and its connected waters in the Myitkyina District, Upper Burma, were described in an earlier paper by Dr. H. S. Rao[1], and the following account deals with the freshwater bivalves of this collection.

Only two families, the Unionidae and the Cyrenidae, are represented in the collection. Of the former family there are species of the genera *Indonaia* Prashad, *Parreyssia* Conrad, *Lamellidens* Simpson and *Trapezoideus* Simpson. Three new species and a variety—*Parreyssia choprae, P. burmanus* var. *myitkyinae, P. olivacea* and *Lamellidens indawgyiensis* —are described as new, and notes on another lacustrine species—*Lamellidens nongyangensis* Preston from the Nongyang Lake, Upper Burma, are also included in the following pages. The several genera of the Unionidae represented in the area are of the usual Indo-Burmese type, and the various species, beyond showing an adaptation to the lacustrine habitat, are of no special interest. The family Cyrenidae is represented by the widely distributed Indo-Burmese species—*Pisidium clarkeanum* G. & H. Nevill—, and the absence of the cosmopolitan forms of the genera *Corbicula* Meg. v. Mühl. and *Sphaerium* Scopoli is noteworthy.

Family UNIONIDAE.

Indonaia bonneaudii (Eydoux).

1922. *Indonaia bonneaudi*, Prashad, *Rec. Ind. Mus.* XXIV, p. 94.

The specific name of this Unionid is *bonneaudii* [2] and not *bonneaudi* as was published by Lea, Simpson, Preston and in my account of the Burmese forms cited above.

In Dr. Chopra's collection the species is represented by a few specimens from Kamaing, Myitkyina District, Upper Burma. All the specimens are young shells not exceeding 30 mm. in length.

Parreyssia tavoyensis (Gould).

1922. *Parreyssia tavoyensis*, Prashad. *Rec. Ind. Mus.* XXIV, p. 104.

In the paper cited above I discussed at length the question of the forms which should be referred to *P. tavoyensis*, and added a few notes

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[1] Rao, H. S.—*Rec. Ind. Mus.* XXXI, pp. 273-299 (1929).

[2] Eydoux, F.—*Moll. Voy. Favorite* in *Mag. Zool.*, p. 10, pl. cxix, figs. 1, 1*a* (1835) also in *Voy. Autour du Monde La Favorite* V, p. 190, pl. lx, fig. 1, 1*a* (1839).

on the variation in the outline of the shells of this species. In view of fresh material in the present collection I have re-examined the entire collection of the species in the Indian Museum, and find that the species is much more variable than I believed.

The species differs considerably in the development of the sculpture in individuals of different ages and in shells from different localities. Young shells from Tavoy, the type-locality, have very clear and well marked zig-zag radial bars over the entire beak area, the bars also extend as strong, subradial folds over the dorsal slope ; in older shells the sculpture is sometimes less distinct, while in specimens with greatly eroded umbones hardly any trace of it may be present. Young shells from Pegu have the zig-zag radial sculpture less impressed and much less regular, and in the older shells the dorsal slope shows only faint wrinkles. In a shell from Arrakan there is hardly any indication of the sculpture. The three shells from Kamaing in the Myitkyina District from Dr. Chopra's collection, which I assign to this species, have the same zig-zag radial sculpture, but the rays are less regular, thicker and more nodular.

The young shells are sub-triangular, while the adults are subovate ; they are moderately inflated, rather solid and markedly inequilateral with high and tumid umbones. The pseudocardinal teeth are moderately strong and very ragged in the left valve.

The species appears to be widely distributed in the whole of Burma and Tenasserim. It may be noted here that, as pointed out in my paper cited above, Benson's *triembolus* and Tapparone-Canefri's *houngdaranicus* are both distinct and in no way related to *P. tavoyensis*.

Parreyssia choprae sp. nov.

(Plate VIII, figs. 1—4.)

Shell small, not exceeding 40 mm. in length ; subelliptical, height about 70 per cent. of the length, slightly inflated, subsolid, very in-

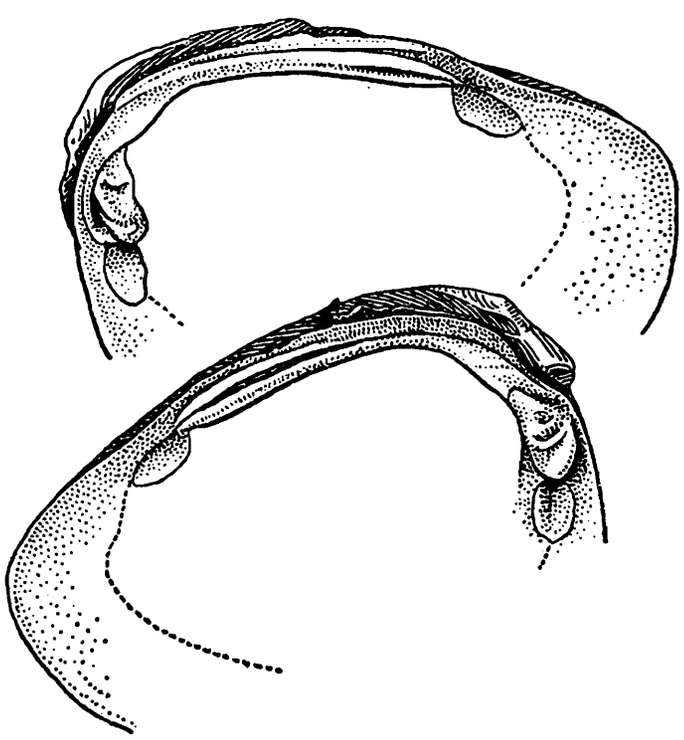

Fig. 1.—*Parreyssia choprae*, sp. nov. : hinge and muscle-scars.

equilateral; umbones high and full, very forwardly placed, recurved outwards and downwards, with a moderately deep cavity; in the young sculptured with fine, low, radial zig-zag bars in the umbonal region, and with slightly thicker, irregular, somewhat arched bars extending over the dorsal slope; in the full-grown adults the sculpture is restricted to the dorsal slope only. Upper margin only slightly arched; anterior margin very short, above rapidly curving inwards between the umbones to be continued into the upper margin and below over the podium to meet the arcuate lower margin; posterior margin subtruncate, forming a subtruncate or even rounded beak which gives the shell a subrostrate appearance; epidermis dark brown in adult, greenish-yellow to brown in young; ligament prominent, brown; hinge-line greatly arched; hinge-teeth moderately strong; pseudocardinals somewhat ragged; outer in right valve thin, almost lamellar, inner triangular-conical, somewhat divided by a deep furrow; two in left valve, anterior triangular, thin, plate-like, posterior thick and knob-like; laterals somewhat arched; anterior muscle-scars deeply impressed, posterior shallow; nacre dull white, porcellanous or with only a trace of iridescence.

Measurements (in millimetres).

	Holotype.						
Length . . .	39	30	28	28	25	24	20·6
Height	30·4	26	26·4	24·5	23	22·5	18
Maximum thickness . .	20	15·5	15·2	14	12·4	13	11

Holotype No. $M\frac{13018}{2}$, in the collection of the Zoological Survey of India (Indian Museum), Calcutta. *Paratype* No. $M\frac{13019}{2}$ in the same collection.

Distribution.—A fair number of young specimens of this species were obtained by Dr. Chopra and his party by dredging along the western shore of the Indawgyi Lake. Large numbers of dead shells were also collected from the southern and western shores. A few specimens were also collected from a hill-stream about five miles from Hopin towards Namna in the Myitkyina District.

Relationships.—*P. choprae* is allied to *P. houngdaranicus* (Tapparone-Canefri), but is distinguished by the umbones being comparatively less prominent, the sculpture less well developed and the ventral margin much more regular. The young shells are similar to those of other species and not so inequilateral. The sculpture on these young shells consists either of small scaly tubercles or of low wavy ridges.

Parreyssia burmanus (Blanford).

1922. *Parreyssia burmanus*, Prashad, *Rec. Ind. Mus.* XXIV, p. 103.

In the paper cited above I included *Unio vulcanus* Hanley and *Parreyssia pernodulosa* Preston in the synonymy of Blanford's species *Parreyssia burmanus*. I have since had the opportunity of examining further material in London and other places, and am of opinion that Hanley's species *vulcanus* is quite distinct and that *P. pernodulosa* is based on young shells of this species rather than of *P. burmanus*.

Blanford's description of the species is complete, but the following additional notes on the sculpture of the shells based on the large series of shells from Kamaing in the Myitkyina District should prove useful for the identification of the species. Young shells usually bear almost vertical, parallel striae which run straight down only for a short distance and then curve forwards regularly or become angulate below the umbonal region to break up into low nodules; the umbonal region of the shells bears zig-zag V-shaped striae. In some cases the arrangement of the striae is not so regular and the striae may be united into regular and V-shaped ridges, while on some shells the sculpture is quite irregular and very faint. In the adult shells, as in the case of the type of the species, the umbonal region, in its upper parts, shows the concentrically plicate striae, while the disc in the middle and up to the ligament has angular, subgranulose, low ridges.

Measurements (in millimetres).

Length	46	44	43	34	33	32
Height	31	30	28	22	23	21
Maximum thickness . .	19·8	21	18·7	15	14	14·4

In Dr. Chopra's collection the species is represented by a large series of shells of all ages from Kamaing in the Myitkyina District, Upper Burma.

The soft-parts of the species may be described as follows: The gills are of very unequal breadth, the outer pair being narrower than the inner almost throughout its entire length; both the pairs of gills are somewhat obliquely truncated along their posterior margins. The inner lamellae of the inner pair of gills are connected for almost $\frac{2}{3}$rd of their length with the abdominal sac, and only the posterior $\frac{1}{3}$rd of the lamellae of the gills of the opposite sides are united to form the diaphragm. All the four gills are marsupial and the margins of the gills even when full of glochidia are sharp. The septa and water tubes are well developed, the water tubes of the outer gill being somewhat narrower than those of the inner. In the males the septa are more distantly situated than in the females. Glochidia not fully developed. The palpi are well developed, somewhat spatulate in shape, and a broad base along which they are attached to the abdominal mass. Foot of fair size, occupying about half of the shell cavity. The branchial aperture is large, with 3-4 rows of elongate, pointed cirri-like papillae of a light brown colour forming a fringe along its margin. The anal is a little more than half the size of the branchial; it is quite smooth and is separated from the branchial by a well developed ridge. The supra-anal, which is about the size of the anal, is separated from it by a mantle connection about equal in size to that of the anal.

Parreyssia burmanus var. **myitkyinae**, nov.

(Plate VIII, figs. 5—7.)

After great hesitation I have decided to separate a series of shells, which were collected at Kamaing in the Myitkyina District with typical shells of *P. burmanus*, as a distinct variety. These shells differ

from those of the typical form in the shells being more triangular, less high, more tumid, more rostrate ; the dorsal margin more sinuous ; the sculpture, which consists of low zig-zag radiating lines, being less pro-

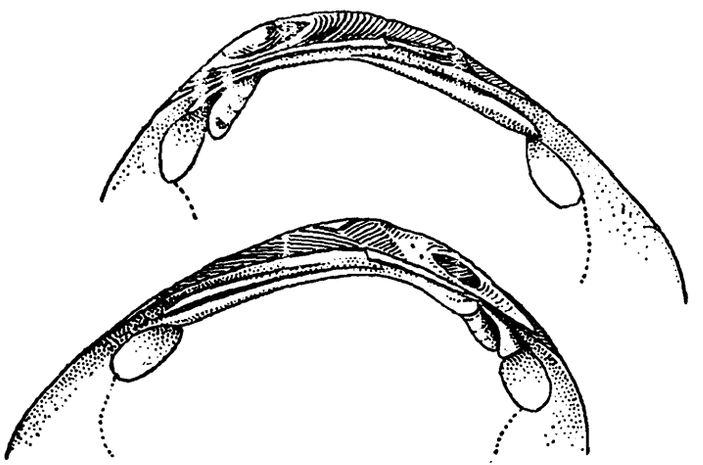

FIG. 2.—*Parreyssia burmanus* var. *myitkyinae*, nov. : hinge and muscle-scars.

minent and confined to the umbonal region. The hinge is built on the same plan as in *P. burmanus*, but the teeth are less strongly developed.

Measurements (*in millimetres*).

	Holotype.					
Length . .	39	38	38	34·8	34·5	30
Height	27	25	24·8	24	24·3	19
Maximum thickness	18	17	16	14·8	15·6	13

Holotype No. $M\frac{13020}{2}$, in the collection of the Zoological Survey of India (Indian Museum), Calcutta. *Paratype* No. $M\frac{13021}{2}$, in the same collection.

Parreyssia olivacea, sp. nov.

(Plate VIII, fig. 8.)

Shell rather small, not exceeding 36 mm. in length, subtriangular elliptical, height about 65 per cent. of the length, subsolid, subinflated,

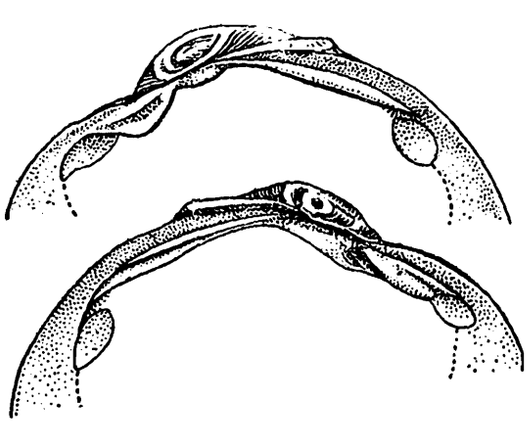

FIG. 3.—*Parreyssia olivacea*, sp. nov. : hinge and muscle-scars.

inequilateral ; beaks high, somewhat inflated, curved forwards, usually eroded, without radial sculpture ; anterior end rounded ; ventral margin

curved, full about the middle then obliquely subtruncated, dorsal slope almost regularly curved, posterior end rounded to subtruncate; epidermis olive green with a trace of yellow below the umbones, shining, feebly rayed; pseudocardinals double in right valve, anterior thin, low, lamellate, posterior sharp, broad, tooth-like; in left valve consisting of a large anterior and a short posterior tooth; laterals low, curved, lamellate; muscle-scars well marked, anterior much more so than posterior; beak cavities deep; nacre iridescent milk-white with an olivaceous blotch in the beak cavities.

Measurements (in millimetres).

	Holotype.					
Length	34	32·8	34·5	35	30	27·8
Breadth	23	22	24·8	24·6	20·5	19
Maximum thickness . . .	14	14	16·7	16·3	13·3	12

Holotype No. $M\frac{13022}{2}$, in collection of the Zoological Survey of India (Indian Museum), Calcutta. *Paratype* No. $M\frac{13023}{2}$, in the same collection.

Distribution.—A good series of this new species was collected by Dr. Chopra at Kamaing in the Myitkyina District, Upper Burma.

Remarks.—*P. olivacea* is a small, smooth-shelled form, and apparently forms a connecting link between the genera *Parreyssia* and *Indonaia*.

Lamellidens generosus (Gould).

1922. *Lamellidens generosus*, Prashad, *Rec. Ind. Mus.* XXIV, p. 67, pl. ii, figs. 12-17.

In the paper cited above I published a detailed synonymy of this species, and discussed the changes in shape and colour of the shells of different ages. In view of a good series of young shells in the present collection it is now possible to supplement these notes still further.

The periostracal colour varies in specimens from different localities. Some shells from Bhamo, Upper Burma, are fulvous or chocolate-brown in the area round the umbo, while the wing and the posterior region of the valves are bright green; along the ventral border the shells are some shade of yellow to brown. A shell from Mandalay of about the same age as the Bhamo shells is dirty green all over. The young shells from Kamaing in the Myitkyina District collected by Dr. Chopra are very thin, almost papery, and are of a dirty brownish-yellow colour. The dorsal slope in these shells is almost straight, and the posterior wing is very well developed; it is more than $\frac{1}{3}$rd the greatest depth of the shells.

The main characteristic features of the species are the anteriorly placed umbones, which are very compressed and not at all prominent, and the two rather sharp, thin and almost parallel anterior cardinal teeth in the right valve.

In Dr. Chopra's collection the species is represented by a number of specimens collected at Kamaing in the Myitkyina District, Upper Burma,

Lamellidens nongyangensis Preston.

1912. *Lamellidens nongyangensis*, Preston, *Rec. Ind. Mus.*, VII, p. 306.
1914. *Lamellidens nongyangensis*, Simpson, *Descr. Cat. Naiades*, p. 1178.
1915. *Lamellidens* (*L.*) *nongyangensis*, Preston, *Faun. Brit. Ind. Freshw. Moll.*, p. 190, figs. 22 ; 1-3.

In my recent revision of the Burmese Unionidae I did not include *L. nongyangensis* Preston from the Nongyang Lake, as I was not quite sure of the location of this lake. Thanks to the courtesy of the Surveyor-General of India I have since discovered that the Nongyang Lake is situated in Burma on the Assam-Burmese Frontier (27° 14′ N., 96° 9′ E.).

The description of the species by Preston is fairly complete except that the author does not mention the moderately developed post-dorsal wing ; this is clearly shown in his figure of the lateral view of the shell. I have seen the type-series of the species in the Indian Museum collection ; it consists of adult shells only, and it is not possible, therefore, to add any notes on the young shells of the species.

Lamellidens indawgyiensis, sp. nov.

(Plate VIII, figs. 9, 10.)

The shell of this species is large (over 100 mm.), elongate-ovate, height roughly 50 per cent. of length, obtusely rostrate posteriorly, rather thick, convex and moderately inflated ; beaks small, not very tumid, lying near the anterior margin, often eroded. Surface marked with low, concentric ridges ; lines of growth not specially impressed. Upper margin almost straight, greatly sloping anteriorly, curving gradually from about the middle into the anterior margin and forming a very obtuse angle with the posterior margin ; lower margin somewhat arched, ascending in its anterior part over the podium, then arched

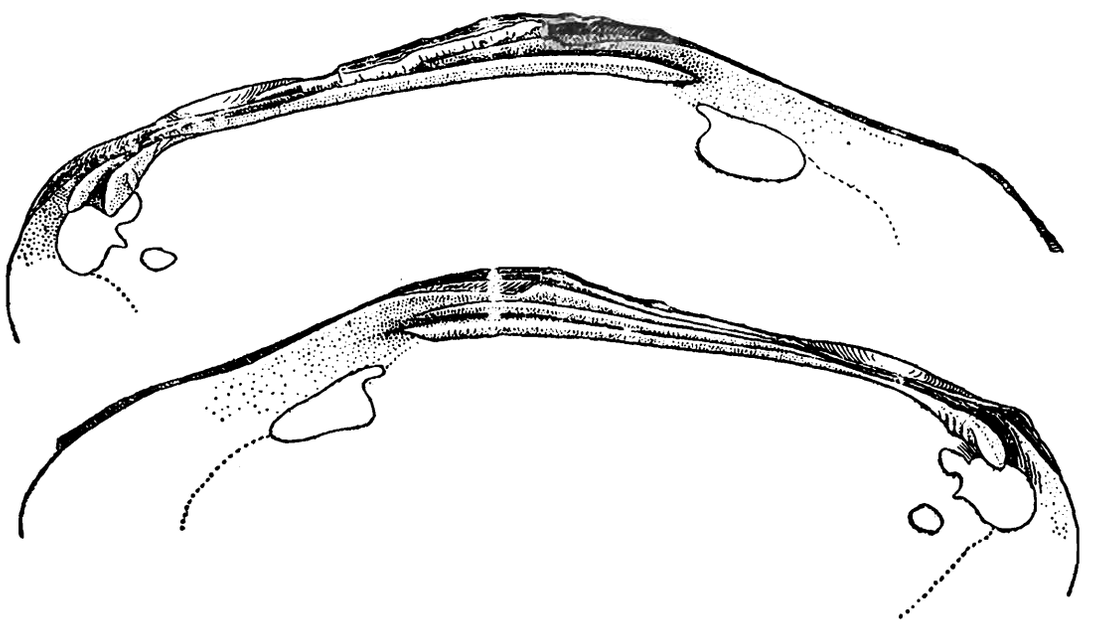

FIG. 4.—*Lamellidens indawgyiensis*, sp. nov. : hinge and muscle-scars.

outwards to about the middle after which it ascends obliquely to form the ventral border of the posterior rostrate process. Anterior margin

narrow, nearly straight but curving backwards near the base to run evenly into the ventral margin of the shell; posterior margin very short. Posterior ridge feebly developed; post-dorsal wing well marked, about ⅓rd the depth of the shell. Epidermis blackish to dirty brown. Hinge-line arched, right valve with two well developed, slightly sloping pseudo-cardinals; upper thin, almost smooth; lower very thick, strong, somewhat rugose; and a single lamellar lateral. Left valve with a single, thick, very ragged pseudocardinal and two rather short, somewhat arched laterals. Muscle-scars shallow but well impressed; anterior separate, posterior confluent. Ligament of moderate length, well developed. Nacre bluish tinged with salmon, slightly iridescent.

Measurements (in millimetres).

	Holo-type.	Para-type.		
Length	108	106	78	101
Height	33	33	24	28
Maximum breadth	56	57	35	54

The first three specimens are from the Indawgyi Lake, while the last one is from Kamaing, Myitkyina District.

Holotype No. M $\frac{13024}{2}$, in the collection of the Zoological Survey of India (Indian Museum), Calcutta. *Paratype* No. M $\frac{13025}{2}$, in the same collection.

Distribution.—A number of specimens of this interesting species were collected by Dr. B. N. Chopra from the Indawgyi Lake; a few specimens taken from Kamaing, in Myitkyina District, about 50 miles from the lake also belong to the same species.

Relationships.—*L. indawgyiensis* forms with *L. phenchoogangensis* Preston and *L. nongyangensis* Preston a very interesting group of species of the genus *Lamellidens*. All the species have greatly elongated, rather narrow and somewhat depressed shells, which are drawn out posteriorly into a rostrate process and have a moderately or well developed post-dorsal wing. The shape and hinge of *L. indawgyiensis* distinguish it from the other two species; it has also a better developed post-dorsal wing and its posterior end is more rostrate. I reproduce a photograph of a young shell of this species dredged by Dr. Chopra from the Indawgyi Lake.

Trapezoideus misellus (Morelet).

1919. *Trapezoideus misellus*, Haas, *Martini-Chemn. Conch.-Cab.* (n. f.), *Unio*, pp. 267-270, pl. xxxii, figs. 6-9, pl. xxxiii, figs. 1-5.
1922. *Trapezoideus misellus*, Prashad, *Rec. Ind. Mus.* XXIV, p. 110.

My remarks about this species in the paper cited above are unfortunately incorrect, they should read " However he wrongly included in it Nevill's *Unio fragilis*, the type of which, as I have stated already, is *T exolescens*; but he was quite right in including in its synonymy Preston's var. *zaleymanensis* of *T foliaceus*, which was described from young and half-grown shells of this species."

A few shells of this species were collected by Dr. Chopra at Kamaing, Myitkyina District, and there is in the collection a single specimen with the animal presevred in spirit.

As, with the exception of the animal of *T dhanashori* described by me in a previous paper[1], the soft-parts of the different species of the genus *Trapezoideus* are unknown, the following notes on the animal of *T. misellus* should prove useful :—Animal with the outer and inner pair of gills of nearly the same width throughout, except near the anterior end, where the outer pair is very narrow ; inner pair of gills united with the abdominal mass on each side along a little more than half of their length, while the lamellae of the two sides in the remainder of their length are attached to one another to form the diaphragm. Palpi very large, spatulate. Mantle entire with a simple margin. Branchial aperture large, of a dark brownish colour with three rows of elongated papillae along the border. Anal aperture smooth, of the same colour as the branchial and about $\frac{2}{3}$rd its size. Supra-anal distinct, slightly smaller than the anal and separated from it by a mantle connection of about the same size. Marsupium formed by all the four gills, edges of the gills when even fully distended sharp. Septa and water-tubes well developed ; water-tubes of outer gills broader than those of the inner. Glochidia not fully developed.

Family CYRENIDAE.

Pisidium clarkeanum G. & H. Nevill.

1925. *Pisidium clarckeanum,* Prashad, *Rec. Ind. Mus.* XXVII, p. 408, pl. vii, figs. 1, 1*a*, 2 ; pl. viii, figs. 1-3.
1928. *Pisidium clarckeanum,* Rao, *Rec. Ind. Mus.* XXX, p. 465.

Unfortunately the name of this species was wrongly spelt as *clarckeanum* instead of *clarkeanum* in my paper cited above.

P. clarkeanum has a wide distribution in India and Burma, and Dr. Chopra collected a good series of specimens of the species from various stations in the Indawgyi Lake.

[1] Prashad, B.—*Rec. Ind. Mus.* XXII, p. 610, fig. 30 (1921).