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VII.—Some Javan Perichætidæ

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VII. - Some Javan Perichætidæ. By W. BLAXLAND BENHAM, D.Sc. (Lond.), Hon. M.A. (Oxon.), Aldrichian Demonstrator in Comparative Anatomy, Oxford.

[Plate III.]

I HAVE to thank Dr. Arthur Willey for collecting some earthworms during his brief stay at Java, on his way to the South Sea, whither he was travelling for the purpose of investigating the development of *Nautilus*. I wish at present to describe three species, which are nearly allied to one another and to others previously recorded from Java.

Several of the Javan species possess a peculiar and characteristic spermatheca; in the majority of the family Perichætidæ the spermatheca consists of two parts—(a) a sac, and (b) a muscular *diverticulum*—having different structure and different functions (see Beddard, Michaelsen, and others). In these particular Javan worms the sac is thin-walled, of large size, and somewhat ovoid in shape; its duct is quite short, and receives a very long diverticulum-longer than the greater diameter of the sac-which is curved round one side of the sac, or, it may be, spirally coiled; this cylindrical tube carries at its free end a small saccule, which communicates with the tube by a very narrow neck. Spermathecæ with such a diverticulum thus constricted near its free end and terminally dilated occur in P. capensis, Horst *, P. operculata, Rosa †, P. Tenkatei, Horst ‡, P. tjibodæ, Horst §, and, as far as I am aware, in no other species ||. In all these species there are two pairs of spermathecæ, opening between the segments 7/8, 8/9, and the anatomy of all is very closely similar; indeed, it is not an easy matter to determine whether all are really different species.

Now, amongst the worms sent to me by Dr. Willey I find two which present certain characters common to the above. I shall have occasion to refer to P. capensis during the description of the new species. This species was first

+ "Die exotisch. Terricol." &c., Ann. des k. k. naturhist. Hofmuseum. 1891, p. 398. ‡ 'Notes from the Leyden Museum,' xv. p. 321.

§ Ibid. p. 326.

P. inflata, Horst (loc. cit.), has a somewhat similar diverticulum. which, however, is dilated below the constriction. Ude's species P. parva appears to be identical with Horst's species.

^{* &#}x27;Notes from the Leyden Museum,' v. 1883, p. 195; and Zool. Ergebnisse einer Reise in Niederl. Ind. herausgeg. v. Dr. Max Weber, ii. 1892, p. 62.

described by Horst in 1883 from an imperfectly preserved specimen; he added new facts about it in 1892, but in neither case does he mention the *colour* of the worm, and it appears to be a very important point to note in the Perichætidæ, as Beddard has already pointed out.

Later still, Ude (1893) *, as a result of his examination of numerous specimens, added the fact that the colour is lighter or darker brown.

Horst and Ude regard Rosa's *P. operculata* as being synonymous with this species; but the latter describes his worm as "flesh-coloured;" and there are one or two anatomical points which seem to me to differentiate the two forms.

The first worm I wish to describe is so distinctively coloured that, although it agrees more or less closely with *P. capensis*, I believe it to be entitled to a new name. I call it after my friend Dr. A. Willey, to whom my thanks are due for his kindness in finding time to collect and carefully preserve these worms.

Perichæta Willeyi, sp. n. (Pl. III. figs. 1-6.)

It is represented by a single mature and well-preserved specimen, collected in the humus around an epiphyte, *Asplenium nidus*, occurring at the Gedeh volcano, near Tjibodas.

The worm measures 140 millim. $(5\frac{1}{2} \text{ inches})$ in length and 6 millim. in diameter; it consists of ninety-two segments. It is thus a larger and fatter worm than the succeeding species. Its coloration in spirit is quite distinct from that of any Perichæte of which I can find a description \dagger , and recalls very strongly the common "Brandling" (Allolobophora fætida).

The general ground-tint is yellow, the rings or ridges carrying the chetæ are white. The dorsal surface of every segment is marked by two transverse bands of rich brownish red—one rather broader band behind the chætigerous ring, and a rather narrower band in front of the ring—so that the intersegmental furrows are yellow. These bands are broadest dorsally, but at each side, below the level of the lateral line, narrow rather suddenly; at the same time the tint becomes lighter, and gradually disappears at about the level of the male pores. Anteriorly these dark bands become wider and send prolongations between the chætæ, so that on the first

^{*} Ude, "Beit. z. K. ausländ. Regenwürmer," Zeit. f. wiss. Zool. lvii.

[†] P. fasciata, Rosa, from Engano, appears to have a somewhat similar plan of colouring (Annal. del Mus. Civico d. Stor. Nat. d. Genova (ser. 2) xii. 1892, p. 543.

six segments or so the white chætigerous ring is interrupted, and each chæta or two or three chætæ lie in a white patch; moreover, on these segments the bands extend further and further ventralwards, till on the first three segments they meet ventrally, though the depth of colour is slightly less here than on the dorsal surface. On the clitellum these bands, though faint, are still recognizable.

Unfortunately Dr. Willey did not inform me of the true colours of the living worm; and no doubt the colours will soon fade in spirit.

A somewhat similar banding occurs in *P. pulchra*^{*}, from Luzon, and *P. pictus*[†], from Borneo; but in both these species the dark bands are intersegmental. The anatomy, moreover, is quite distinct. In *P. annulatus*, Horst[‡] states that the worm is "blackish, with a white ring round the middle of each segment." But in these three cases no mention is made of the light intersegmental ring.

In *P. Willeyi* the *chætæ* form practically a complete circle, but the median dorsal space is about twice the length of the ordinary intersetal spaces; and across this space there is frequently a dark line joining the dark transverse bands; so that the worm appears to have a darker longitudinal median stripe along its back. The ventral chætæ are somewhat closer together than the dorsal ones; there is no ventral gap. The number of chætæ is 54 on the thirty-fifth segment, 48 on the nineteenth, 44 on the twelfth, 28 on the second.

The *prostomium* is small and not dovetailed; but as the buccal region is everted, it is difficult to be positive on this point. The limits of segments i. and ii. quite distinct.

The *clitellum* is confined to the three segments xiv., xv., xvi., and has very distinct limits.

The first *dorsal pore* is between segments xii. and xiii.; there are none on the clitellum, nor are chætæ present here.

The male pores are very evident, slightly oblique, curved slits surrounded by a prominent margin, which is anteriorly crenate, but posteriorly rounded and more projecting (as in *P. operculata*, where, however, the "operculum" is formed by the anterior lip). Surrounding the projecting margin or lips is a circular area reaching to the boundaries of the segment. There are ten chætæ between the male pores.

The oviducal pore is median and distinct. There are two

^{*} Michaelsen, "Terricol. d. Berliner Zool. Sammlung," Arch. f. Naturgesch. 1892, p. 25.

[†] Ibid. p. 38.

t 'Notes from the Leyden Museum,' v.

pairs of *spermathecal pores*, between segments vii./viii. and viii./ix., and separated by fourteen chætæ.

Internal Anatomy.—It may be noted that the gizzard occupies segments viii., ix., and x., and is of the same shape as in *P. capensis*, viz. bell-shaped. The sacculated intestine commences as usual in segment xv.; there is a pair of cæca in segment xxvi., their blind ends reach to the twenty-third segment. The septa viii./ix. and ix./x. are absent.

The sperm-sacs have the usual position.

The large spermathecæ lie in segments vii. and viii. The tubular diverticulum is spirally coiled or merely curved, just as Ude has observed to be the case in *P. capensis*. As a matter of detail, those of segment vii. were coiled, those of the eighth were more simply curved, apparently because of the greater space in which the organs lie. When spirally coiled the terminal saccule lies in the axis of the spire, as in fig. 4; when curved it is bent sharply round.

The prostate is multilobate, but the lobes differ in shape from those of *P. capensis*; they are longer, less rounded at their ends, and more flattened. The organ is about twice as long as it is wide, and is more opaque, of a more dead white colour than in the species next to be described. The penial duct does not open into any apparent bursa.

It will be seen that in one or two points *P. Willeyi* resembles *P. operculata*, Rosa, and *P. capensis*, Horst; but it differs from both in the position of the spermathecæ, and, in the single specimen at my disposal, in the size and coloration.

In the character of the generative pore it resembles to some extent P. operculata; but I confess that I do not lay great stress on this, for I believe that the "operculum" externally and the absence of a "bursa" internally are related and depend on whether the penial duct is or is not fully introverted.

I am inclined to lay considerable stress on the colour and dimensions of the worms, for in our endemic forms these characters are very constant; and in other groups of animals colour—within certain limits, varying in different groups—is a useful specific character. We have yet to learn how far the size of the prostate and the size of the diverticula of the spermathecæ are liable to variation, either in relation to functional activity or to other circumstances, though I believe it would be useful to have careful measurements of the length and breadth of the prostate, for probably the proportions of the organ remain fairly constant. Further, the shape of the lobes in this organ ought to be noted; most authors are content to describe the prostate as "multilobate," or some such term.

Michaelsen^{*} has recently shown that in one and the same species, viz. *P. indica*, the prostate may present differences in size, and may even be absent, though the specimens are otherwise mature. He had previously noted this lack of prostate in *P. Hilgendorfi*[†]; and Beddard [‡] records the same fact for two other species, *P. nipponica* and *P. masatakæ*. The last three species are Japanese (Beddard's *P. rokugo* appears to be identical with *P. Hilgendorfi*, Mich.). Michaelsen suggests that these species are all closely allied to *P. indica*.

Perichæta sexta, sp. n. (Pl. III. figs. 7-9.)

Two specimens were collected at Buitenzorg.

The general colour (in spirit) is a rich brown anteriorly and dorsally, becoming lighter posteriorly; the ventral surface is yellowish; running down the middle of the back is a dark line. The chætæ are set in narrow light (? white) rings, which become less marked anteriorly, till in the first six or seven segments the rings are scarcely noticeable. A purplish iridescence is exhibited by the anterior region of the body. The dorsal pores are surrounded by a light ring, or, rather, the lips are light (? white), so that the pores are very distinct. The clitellum is a much darker brown. This coloration agrees with that of *P. capensis*, as described by Ude, except that no mention is there made of the dorsal pores.

The two specimens differ in *length*: one is 95 millim. long and 4 millim. in diameter, and possesses eighty-two segments; while a smaller and immature specimen consists of one hundred segments.

The small *prostomium* is dovetailed into the peristomium (buccal segment) for about one third the length of the latter; but as there is no transverse boundary, it is difficult to fix the actual depth of the dovetail (Ude and Horst say that in *P. capensis* it reaches nearly to the middle of the first segment).

The number of chætæ is fifty-six behind the clitellum and thirty-eight on the third segment (which closely agrees with the numbers for P. capensis). They form a complete circle, though the distance between the two most dorsal chætæ

^{* &}quot;Die Regenwurm-Fauna von Florida und Georgia," Zool. Jahrb. viii.

^{† &}quot;Terricol. d. Berliner Zool. Sammlung," ii. p. 27, in Arch. für Naturgesch. 1892.

t "On some Perichætidæ from Japan," Zool. Jahrb. vi.

exceeds slightly the usual interval; however, the spaces between the chætæ of a circle are not of uniform extent.

The first *dorsal pore* is behind the seventh segment; that this is not a fixed point appears from the description of *P. capensis* given by Horst and by Ude, for the latter found it to vary from vii./viii. to xi./xii.

The male pores are not carried by papillæ; they are, however, quite distinct, as transverse slits surrounded by crenate lips, rather sunk below the general surface. Each pore is surrounded by a circular area-not a papilla-of slightly different structure and appearance from the rest of the epidermis; this ring does not extend to the intersegmental furrows. Between the two pores there are eight chata; there are eight to twelve in Horst's and Ude's specimens of P. capensis. Horst describes the pore as being oblique and carried by a papilla; Ude states that it is "sickle-shaped," and that one lip of the pore projects as a kind of operculum, as in Rosa's P. operculata. This difference should be borne in mind, for, as I have mentioned, I believe it depends on whether the penial duct is wholly or only partly retracted, so that it does not form an important point of distinction.

The spermathecal pores are not very distinct; they are situated between segments vii./viii. and viii./ix., rather more laterally than the male pores.

The oviducal pore is distinct, light-coloured (? white), and median.

Internally the anatomy agrees very closely with the descriptions already given for *P. capensis*; but there are one or two points of difference, the relative importance of which is not altogether certain. The septa 8/9, 9/10 are absent, and the *gizzard* occupies the whole length of the space between septa 7/8 and 10/11—that is to say, it occupies segments viii., ix., x.,—whereas both Horst and Ude for *P. capensis* refer it to only the first two of these segments. Horst states that the septum 10/11 is absent; Ude finds it present.

There is the usual pair of intestinal cæca in segment xxvi.; each has a length of three segments.

The sperm-sacs lie in segments xi. and xii.

The spermathecæ are in segments vii. and viii.; and it is here that the only real tangible difference exists between my specimen and those previously described, for both the abovenamed authors place these sacs in segments viii. and ix. But there is no mistake on my part; the first spermatheca is in front of the gizzard, the second lies alongside of it. Each spermatheca has the characteristic shape already referred to, and already figured by Horst and by Ude for *P. capensis*, though there is a slight difference in the two drawings; the diverticulum in the figure (pl. iii. fig. 25) of the former is relatively longer and narrower than in Ude's figure (pl. iv. figs. 8, 9) or in my own. Is this a specific difference, or is it merely due to a difference in functional activity? Certainly Horst's drawing more nearly resembles the spermatheca of the worm described above (P. Willeyi, sp. n.), and Ude's resembles Rosa's P. operculata, which is regarded as a synonym of P. capensis.

Another character which always has to be noted in the Perichætidæ is that presented by the *prostate*. In the present worm it is more than three times as long as wide (its actual measurement is 7×2 millim.), and consists of very many rounded notched lobes, forming as a whole a flattened, slightly yellowish organ, which extends through segments 16-20. From near the middle of its inner border the penial duct issues, at first narrow, with thin wall, but soon becoming wider and having muscular walls. It opens into a circular flattened "bursa," as is figured by Horst for *P. capensis*.

Thus the only differences between this present worm and *P. capensis* appear to lie in the position of the spermathecæ (and it is to be noted that in one of Horst's specimens a third spermatheca occurred on one side of the worm in segment vii.) and in the character of the male pore; and although my worm agrees in nearly all other features with *P. capensis* or with *P. operculata*, yet, as these two points are regarded as of specific value, I give a new name to this worm. Nevertheless I conceive that it is quite possible that it may be a hybrid or an abnormal specimen.

The five species, *P. capensis*, *P. operculata*, *P. tjibodæ*, *P. sexta*, and *P. Willeyi*, are very closely allied, and came from the same neighbourhood; to these must be added *P. Tenkatei*, Horst, from the island of Soemba. They all have two pairs of spermathecæ, with peculiarly modified diverticulum: they all have a much lobed prostate. All agree pretty well in size—from 50 millim. in *P. tjibodæ* to, more commonly, 100 millim., as in *P. capensis*, the largest being 140 millim. (*P. Willeyi*). The number of segments, too, does not vary to any great extent—again, *P. operculata* forms the first and lowest of the series, with its sixty segments; the others have one hundred or a few more.

The number of chætæ in a postclitellian ring appears to be about fifty to fifty-six (Rosa does not give any number for this region), which is reduced to about thirty-eight in the region of the spermathecæ.

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In none of them is the male pore carried by a prominent papilla, but the shape of the pore appears to some extent diagnostic—that is, it may be transverse to the axis of the body, as in *P. sexta*, or more or less oblique; and some of them are stated to have an "operculum." I think we may leave this feature out of our reckoning. There remains, then, but very few points, and these are very small, which serve to distinguish these five species.

I have already suggested that (1) the relative length and breadth of the diverticulum, (2) and of the prostate, with a careful drawing of the lobes of the latter, (3) the form of the prostomium, (4) the general coloration, and (5), within certain limits, the size and number of segments of the worm are points that should be carefully recorded. Sundry other anatomical characters occur in other groups of species of What I have written above refers more particu-Perichæta. larly to this particular "capensis" group of species from Java; so closely allied are they that it seems possible that their common ancestor is not many generations back. It is very difficult to distinguish some of these six species from one another by a mere study of the descriptions; and it may well be that two or more are varieties or synonyms.

I append, therefore, a table (p. 48) illustrating the more important apparent differences.

Perichæta caducichæta, sp. n. (Pl. III. figs. 10-12.)

Three specimens of a rather slim worm possess characters which do not exactly coincide with other Javan worms. One very striking feature is the *absence of chætæ on the tenth segment* in adult worms. Of the three specimens one—the most mature—was collected on the volcano Gedeh, the two others at Buitenzorg.

They measure 120, 130, 133 millim. respectively, and the diameter is 3 to 4 millim. The body tapers somewhat anteriorly, and the colouring is faint in the preserved specimens. There is a dark purplish line along the middle of the back; the dorsal surface of the body anteriorly is light purplish brown, and each segment is marked by a white chætigerous ring. The *clitellum* is darker and browner; there are no chætæ on it, but three faint light rings; it occupies the usual position.

The following description refers to the largest of the three specimens :—It consists of 105 segments, the last three of which are without chætæ.

ľ		-							
	Colour.	Size.	Seg- ments.	Chætæ.	First dor- sal pore behind	Male pores.	Segment with sper- matheca.	Spermathecal diverticulum.	Prostate duct.
:	Brown; light or dark.	mm. 85–110 ×3–4	90-110	50; 40 on viiith	viii. to xi.	Oblique, separated by 8-12 chætæ.	viii., ix.	Long, narrow, coiled; orshorter, wider,and curved.	Nearly straight ; a bursa.
ta.	Flesh-coloured ; brown clitellum.	70×5	60	f 40 on viith	viii.	Oblique, with "operculum."	viii., ix.	Short, wide, curved.	Straight; no bursa.
	۵.	85	100	50	xi.; also on clitellum.	Oblique, with operculum.	۵.	Long, wide, curved.	۵.
:	Olive-brown; grey anteriorly and cli- tellum.	50	۵.	44	۵.	Triradiate, eight chætæ between.	vii., viii.	Short, wide, curved.	Much coiled ; bursa.
•	Transversely dark- striped; interseg- mentallightrings.	150×6	93	54	xii.	Oblique, with operculum; ten chætæ between.	vii., viii.	Long, narrow, coiled or curved.	Straight; no bursa.
:	Brown.	95×5	82-100	56	vii.	Transverse, eight chætæ between.	vii., viii.	Long, thick, curved or coiled.	Curved, with bursa.

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The number of *chætæ* is 38 on segment xxiii.

			30		viii
"	"	"	00	"	
"	"	"	20	,,	1V.
,,	,,	"	12	"	ii.

There is a slight dorsal gap, equal to two to three times an ordinary gap.

There are no chætæ on the tenth segment in this specimen; in one of the others there are but six at very unequal distances on the ventral surface, and in the third specimen twelve.

It appears, then, that the chætæ drop out of this segment on maturity, a peculiarity hitherto unrecorded amongst earthworms.

On segment xi. there are fewer chætæ than on ix. or xii.

The segments x., xi., xii. are distinctly triannulated, and, though scarcely perceptibly larger in the spirit-specimen, it is quite possible that they may be larger in life. Such a fact has been recorded for *P. falcata*, Horst *, from East Flores, and in the case of *P. Sluiteri*, Horst †, from Billiton; and the same author noted that the tenth segment of *P. indica* is larger than its neighbours. But in no case do I find any record of the *absence* of chætæ on this segment.

The *prostomium* is long and narrow and dovetailed into the first segment for three fourths of its length.

The first dorsal pore is between segments xii./xiii.

The male pore is slit-like, with crenate lips slightly projecting, so as to form rather prominent structures; there are six chætæ between the two pores.

The two pairs of *spermathecal pores* are scarcely visible; they lie between segments vii./viii., viii./ix., at about the level of the ninth chæta from the ventral mid-line.

The oviducal pore is as usual.

Internally the septa viii./ix., ix./x., x./xi. are absent, and the gizzard appears to occupy segments viii., ix., and x. The pair of intestinal cæca arise in segment xxvi., and reach as far forward as xxii.

The sperm-sacs are, as usual, in xi. and xii.

The spermathecæ are characteristic; they lie in segments viii., ix.; each consists of a nearly globular thin-walled sac, opening by a short, thick, muscular, distinct duct at the anterior margin of these segments. This duct receives a long twisted diverticulum, which gradually enlarges distally, and here appears shining. On one side this diverticulum lies

* 'Notes from the Leyden Museum,' xv. p. 316.

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† Ibid. vol. xii. p. 234.

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anteriorly to the septum, *i. e.* in segment vii., the sac being in segment viii.

The prostate is relatively small; it measures 4×3 millim.; so that the general outline is nearly circular; it occupies segments 17-19. It is divided into only a few main lobes, each of which is rounded distally and notched in a variety of ways; the penial duct is short and straight, and opens through a feebly marked circular "bursa."

Though this worm bears a general likeness to several other species from Java and the neighbouring region, yet on comparison I have been unable to identify it with any of these. In general form it recalls *P. indica*, Horst *, which, however, possesses four pairs of spermathecæ, and the ventral chætæ are larger than the rest. *P. falcata*, Horst, from East Flores, has more numerous (sixty) chætæ, and the diverticulum of the spermatheca is very much shorter than in my specimens, though the two structures bear a close resemblance to one another; the prostate is much more deeply lobed.

P. sumatrana, Horst †, is only about half the size of the new species, though it possesses about the same number of chætæ; the spermatheca appears to be somewhat similar.

Again, P. Sluiteri, Horst, from Billiton, is larger, has more numerous chætæ, which are distinctly closer together ventrally; the spermathecæ have a terminally dilated diverticulum; and the prostate recalls that of the worm just described.

All these worms seem to belong to a group of species differing from that containing *P. Willeyi*, *P. tjibodæ*, &c. in the character of the spermathecal diverticulum, and in the presence of less numerous chætæ per segment, as well as in a few other points; but these are details, and the two groups are not very widely separated from one another.

EXPLANATION OF PLATE III.

Perichæta Willeyi, sp. n.

Fig. 1. Portion of the worm, dorsal view, to show banding.

- Fig. 2. Side view of a portion of the worm. The arrow indicates the anterior direction.
- Fig. 3. View of the male pores.
- Fig. 4. A spermatheca from the seventh segment, \times 7. s, sac; d, diverticulum; e, terminal saccule.

^{* &#}x27;Notes from the Leyden Museum,' v.; and Beddard, Proc. Zool. Soc. 1886 and 1890.

^{† &#}x27;Notes from the Leyden Museum,' v.

Fig. 5. A spermatheca from segment viii., \times 7. Letters as before. Fig. 6. Prostate, \times 7.

Perichæta sexta, sp. n.

- Fig. 7. Male pores. Unfortunately the lithographer has indicated ten chætæ, instead of eight, between the male pores.
- Fig. 8. Prostate, \times 7. *a*, penial duct; *b*, bulbus.
- Fig. 9. Spermatheca, \times 7. Letters as before.

Perichæta caducichæta, sp. n.

- Fig. 10. Segments ix., x., xii., \times 7, to exhibit annulation of segments and the absence of chætæ on segment x.
- Fig. 11. Prostate, \times 7.
- Fig. 12. Spermatheca, \times 7.

VIII.—Descriptions of Five new African Shrews. By OldField Thomas.

IN examining a shrew obtained by Dr. Donaldson Smith's expedition in Somaliland an attempt has been made to determine the other African shrews in the British Museum collection, with the result that the following species prove to need description :—

Crocidura (Croc.*) Smithii, sp. n.

Coloration that characteristic of the *C. albicauda* and *Fischeri* group, but size smaller than in any known species of it. Face, crown, and back pale slaty grey; lips, cheeks, chin, chest, sides, and belly white, as are also the whole of the limbs. Ears short, almost naked, their few fine hairs brown. Lateral glands distinct (in male), the hairs above and below them stained rufous in the type. Tail barely half the length of the head and body, thick, tapering, rather thinly haired, pure white throughout.

* In using the terms "Crocidura" and "Pachyura," I do so only because they serve as convenient formulæ by which the number of the teeth may be most readily shown. In agreement with Dobson, Lataste, Trouessart, and others, I have little doubt that they do not represent natural genetic groups, and that, for example, the large Pachyuræ are more closely allied to the large Crociduræ than they are to the pygmy species having the same dental formula. In fact, some four or five cases are known in which a specimen is a Pachyura on one side of the mouth and a Crocidura on the other, although it must be admitted that, on the whole, there is a great constancy as to the presence or absence of the fourth unicuspid within any given species, and that we ought not to allow ourselves to be too much influenced by such exceptional cases as these. Pending further knowledge on this most difficult subject, I prefer to use the large genus Crocidura, taking advantage of the subgeneric terms simply to indicate the dental formulæ of the species described.

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JAVAN PERICHÆTÆ