NOTE

ON A NEW KEY OF THE GENUS *PROCAMALLANUS* WITH A HISTORICAL REVIEW

The genus *Procamallanus* was created by Baylis, 1923 with *P. laeviconchus* (Wedl, 1862) as its type. While creating this genus he also described in 1923 *Procamallanus spiralis* from a single male specimen from a siluroid fish *Hetrobranchus anguillaris* from the Nile river at Cairo. Later in the same year Baylis (1923b) expanded the description by adding detailed measurements of the female but certain details relating to the caudal papillae of the male were lacking. In 1927, Fujita from Japan described *P. parasilum* from a siluroid fish. Travassos (1928) added three more species to the genus *Procamallanus* namely *P. inopinatus*, *P. iherengi* and *P. rarus* from siluroid fishes in Brazil. Baylis (1929) discovered *P. xenopoides* from a betrachian in Egypt. Agrawal (1930) described *P. mehrii* from an Indian siluroid fish which was redescribed by Khera in 1955. Tornquist (1931) redescribed the species (*P. spiralis*), cited its new host (Host being *Crenidens forskalli*, *Sargus noct* and *Chilinus trilobatus*) and added details of the morphological and cytological features of both male and female worms. Tornquist (1931) also published a monograph on *Cucullanidae* and *Camallanidae* in which he described *P. sphaerochonchus* from a siluroid fish in Europe. Vaz and Pereira (1934) described two species *P. hilari* and *P. amaradi* from Brazil fishes. In 1935, Pearse added *P. kerri* from Siamese fish basing his descriptions on a single female. In the same year, i. e., 1935, six more species were added to the genus *Procamallanus*, three of these, *P. wrighti*, *P. fariasi* and *P. barrosloimai* by Pereira from Brazil, *P. sigani* by Yamaguti from Japan, *P. fulvidraconis* by Li from China and *P. planoratus* by Kulkarni from India, all from siluroid fishes. In the subsequent year Pereira added one more species, *P. cearnsis* from Brazil. In 1937 *P. solmei* was described by Southwell and Krishner from a betrachian (toad) in South Africa. Johnston and Mawson (1940) reported another species, *P. murreyensis* from an Australian fish. In 1941, Yamaguti described *P. lonis* from a Japanese fish. In 1946, *P. pereirai* another species was described by Annereaux who developed a key for the 22 existing species of the genus *Procamallanus*. His paper included the first report of the genus in North America. In 1948, *P. brevis* was added by Kung from a betrachian host in Africa. In the year 1952, Olsen published a paper which was concerned with *P. pereirai* and also divided the genus into *Procamallanus* and *Spirocamallanus*. He also described a new species which he placed in the new genera *Spirocamallanus*. The genus *Procamallanus* was restricted to those species having a smooth buccal capsule lining. The new genus was characterised by spiral thickening on the inner wall of the buccal capsule. In 1953, Winter reviewed the literature on these nematodes and redescribed *Spirocamallanus spiralis*. He worked on parasites from Mexico and based his account on females only. In 1955, Sogandares-Bernal established a new host-record for *S. pereirai* from Louisiana. In 1955 S. Khera described two new species of *Procamallanus*, *P. aspiculus* from *B. bagarius* and *P. gubernaculus* from *Rita rita*. Ali (1956) in India modified the key developed by Annereaux. He developed

a key for the identification of the species of the original genus *Procamallanus*, but the key is based on certain measurements which do not correspond to some of those previously reported. The worms described by Ali were, *P. heteropneustes*, *P. clarius*, *P. singhi*, *P. hydrabadensis* and *P. viviparus* all recorded from siluroid fishes of fresh water of India. In 1960, he again reported two more new species of *Procamallanus* namely *P. globochonchus* and *P. ophiocephalus* from *Rita hastata* and *Ophiocephalus* giving a fresh key to the genus *Procamallanus*. In the same year i. e., 1960 Yeh Liang Sheng wrote on a reconstruction of the genus *Camallanus* in which he divided *Camallanidae* into two subfamilies, *Procamallaninae* and *Spirocamallanus* while the latter includes *Camallanus* (Railliet and Henry, 1915), *Camallanides* (Baylis and Daubney, 1922), *Procamallanus* (Yorke and Maplestone, 1926), *Piscilamid* gen. nov, *Serpenema*, gen. nov, and *Zeylanema* Yeh, 1960). In 1965, Sinha and Sahy wrote on the validity of the genus *Indocamallanus* Chakravarty et al. and discovered *P. (monospiculus) devendri* n. sp. ; in the same year Sinha and Sahay reported a new *Spirocamallanus* from *E. Vacha*. Sahay reported in late 1965 *Spiro Camallanus Chauhani* n. sp. ; from *Myxus cavasius*.

Key to the Genus *Procamallanus*

The key to the genus *Procamallanus* has been given by Annereaux (1946), Khera (1955), Ali (1956 ; 1960). If the key is amended in view of the recent works of Olsen (1952) and Yeh Liang Sheng (1960), it would facilitate the study of known species of the genus. The author does not agree with Khera (1955) who included *P. gubernaculus* in *Procamallanus* and not in *Spirocamallanus*. The author also fails to understand why Ali (1960) included *P. gubernaculus* Khera, 1955 in *Procamallanus* when *P. gubernaculus* is provided only with one spicule. Ali (1960) seems to be mis-informed about it as is evident from his key in which he mentions *P. gubernaculus* as having two spicules, the right one measuring 0.29 mm and the left one 0.06 mm. It has been clearly mentioned in the account given by Khera (1955) published in *Anales de la Escuela Nacional de Ciencias Biologicas*, VIII (3-4): 243-252 Mexico that the spicules referred to above is without the left spicule. An accessory piece cannot be regarded as a spicule. Besides the inclusion of all the *Spirocamallanids* in the subgenus *Procamallanus* does not seem to be sound. Ali gave his key in 1956 modifying the key developed by Annereaux and he described five new species of *Procamallanus* three of which should have been placed in *Spirocamallanus*. Most probably Ali did not note the paper by Olsen.

The following key is a modification on Annereaux's, Khera's and Ali's key to the genus *Procamallanus*. *P. kerri* Pearse, 1933 known from female specimens only has not been included in the key.

Key to the Species of the Genus *Procamallanus*

1. Subgenus — *Aspiculus* Ali, 1960.
 - Buccal capsule with semi-lunar cuticular thickenings and a pair of golf-club-shaped-projections, spicules absent..... *P. aspiculus*, Khera 1955.
2. Sub-genus — *Monospiculus* Ali, 1956.
 1. Buccal capsule without spiral thickenings 2
 2. With only one spicule *P. slomei* Southwell and
Krishner 1937

With one spicule+Y shaped gubernaculum+tail of female bifur-

- cated at tip *P. (monospiculus) deven-dri* n. sp. Sinha and Sahay 1965
- Gubernaculum otherwise+female tail without bifurcation..... *P. (monospiculus) heteropnuesti* Chakravarty et al. 1961.
3. Subgenus — *Isospiculus* Ali, 1956.
1. Buccal capsule without spiral thickening, Spicule 0.45 mm long, 8 caudal papillae,..... *P. wrighti* Pereira, 1935.
 - Buccal capsule without spiral thickenings & spicule shorter..... 2
 2. 7 pairs of caudal papillae, spicule 0.05 mm long..... *P. ceansis* Pereira, 1935.
 - 8 pairs of caudal papillae, spicules 0.12 mm long *P. inopinatus* Travassos, 1928.
 - 13 pairs of caudal papillae, spicules 0.11 mm long..... *P. xenopoidis* Baylis, 1929.
4. Subgenus — *Procamallanus* Baylis, 1923 and Ali, 1956.
1. Buccal capsule without spiral thickenings 2
 2. Gubernaculum present..... *P. annulatus* Yamaguti, 1954.
 - Gubernaculum absent 3
 3. Spicules short, more than 12 pairs of caudal papillae..... 4
 - Spicules longer, 12 pairs or fewer Caudal papillae..... 5
 4. Vulva equatorial or subequatorial, female tail with caudal spines. 6
 - Vulva near the posterior end, female tail without caudal spines... 7
 5. Caudal papillae 12 pairs, female tail with caudal spines *P. sphaeroconchus*, Tornquist, 1931.
 - Caudal papillae 9 pairs, female tail without caudal spines 8
 6. Right spicule 0.15 mm long, left spicule 0.05 mm long. 14 pairs of caudal papillae..... *P. laeviconchus* (Wedl) Baylis, 1923
 - Right spicule 0.089 mm long, left spicule 0.039 mm long, 16 pairs of caudal papillae..... *P. brevis* Kung, 1948
 7. Right spicule less than twice as long as left spicule (R. S-0.07 ; L. S-0.04 mm) 13 pairs of caudal papillae..... *P. heteropnuestes* Ali, 1956.
 - Right spicule three times as long as left spicule (R. S-0.085 mm ; L. S-0.029 mm), 14 pairs of caudal papillae..... *P. clarius* Ali, 1956
 8. Right spicule 0.04 mm long ; L. spicule 0.12 mm ; circum anal papillae three pairs *P. sigami* Yamaguti, 1935.
 - Right spicule 0.05 mm ; L. Spicule-0.22 mm long circum anal papillae absent *P. lonis* Yamaguti, 1935.
5. Subgenus — *Spirocamallanus* Subgenus Nov.
1. Buccal capsule with spiral thickenings 2
 2. Single spicule..... 3
 - Isospiculus* 4
 - Spicules unequal 5
 3. Buccal capsule with lateral finger shaped thickenings parallel to it, gubernaculum present 3a
 - 3a. Tail of female bluntly rounded with vulvular appendage *P. gubernaculus* Khera, 1955.
 - 3b. Tail of female bifurcated without vulvular appendage..... *S. chauhani* n. sp.
 - Buccal capsule otherwise..... *P. parasiluri* Fujita, 1927.
 4. Spicules 0.25 mm long, 11 pairs of caudal papillae..... *P. mehrii* Agarwal, 1930.
 - Spicules 0.12 mm long, 8 pairs of caudal papillae *P. planoratus* Kulkarni, 1935.

5. Spicules similar in shape 6
- Spicules dissimilar in shape 7
6. Gubernaculum present..... *P. bagarii* Karve and Naik, 1951.
- Gubernaculum absent 8
7. Right spicule three times longer than the left (R. S-0.18 ; L. S-0.06 mm), caudal alae meet ventrally *P. viviparus*, Ali, 1956.
- Right spicules more than three times longer than the left, caudal alae lateral..... 9
8. Inner thickenings of the buccal capsule with few thick spirals ... 10
- Inner thickenings of the buccal capsule with 8 or more thick spirals 11
9. Circum anal papillae present..... 12
- Circum anal papillae absent 13
10. Right spicule 0.53 mm left spicule 0.25 mm, spirals in males 4-5, female 14-16..... *P. iheringii* Travassos et al. 1928.
- Right spicule 0.43 mm, left spicule 0.17, spirals in males 3-4, female unknown *P. rarus* Travassos et al. 1928.
11. Spicules long, right spicule at least 0.2 mm 14
- Spicules much smaller..... 15
12. 2 pairs of circumanal papillae *P. ophicephalus* Ali, 1956.
- 3 pairs of circumanal papillae 16
13. 10 pairs of caudal papillae, right spicule four times longer than left (R. S-0.2 mm ; L. S-0.05 mm) *P. hydrabadensis* Ali, 1956.
- 11 pairs of caudal papillae right spicule five times longer than the left (R. S-0.2 mm, L. S-0.04 mm) female tail with caudal spine *P. singhi* Ali, 1956
14. 7 pairs of caudal papillae 17
- More than 7 pairs of caudal papillae..... 18 and *P. murrayensis* Johnston and Mawson, 1940.
15. Spicules 0.1 mm or more, 9 or more caudal papillae..... 19
- Spicules less than 0.1 mm, fewer caudal papillae..... 20
16. Right spicule five times longer than left (R. S-0.15 mm L. S-0.03 mm), 13 pairs of caudal papillae..... *P. globoconchus* Ali, 1960.
- Right spicule eight times longer than left (R. S-0.24 mm ; L. S-0.03 mm) 14 pairs of caudal papillae *P. fulvidraconis* Li, 1935.
17. Caudal alae meet ventrally, 2 pairs of sessile adanals and one pair of adanal *P. monotaaxis* Olsen, 1952.
18. 9 pairs of caudal papillae, female tail with caudal spines..... *P. pereirai* Annereaux, 1946.
- 14 pairs of caudal papillae, female tail without caudal spines..... *P. amarali* Vaz and Pereira, 1934.
19. Right spicule 1/3 longer than left (R. S-0.15 mm L. S-0.10 mm), 7 caudal papillae *P. spiralis* Baylis, 1923.
- Right spicule less than 1/3 longer than left (R. S-0.11 mm ; L. S-0.10 mm) 9 caudal papillae *P. fariasi* Pereira, 1935.
20. 8 pairs of caudal papillae, right spicule 0.08 mm, left spicule 0.06 mm *P. hilari* Vaz and Pereira, 1934.
- 6 pairs of caudal papillae, right spicule 0.06 mm left spicule 0.05 mm..... *P. barroslimai* Pereira, 1935.

Summary :

Various workers have given the key to the genus *Procamallanus*. Such keys have been modified after proper amendment in view of the work of Olsen (1952) and Yeh Liang Sheng (1960). A new subgenus *Spirocamallanus* has been added to the existing list of four subgenera created by Ali in 1960. The forms having spiral thickenings in the buccal capsule have been referred to this new subgenus. *P. parasiluri* Fujita, 1927 formerly kept in the subgenus *Monospiculus* by Ali, 1960; *P. mehrii* Agrawal, 1930 and *P. planoratus* Kulkarni, 1935 both referred to in the subgenus *Iso spiculus* by Ali, 1956 and those forms formerly placed in the subgenus *Procammallanus* with the spiral thickenings in their buccal capsule have been transferred in the new subgenus. *S. chauhani* sp. nov. has been referred to this new subgenus. *P. (monospiculus) devendri* sp. nov. Sinha and Sahay, 1965 and *P. (monospiculus) heteropneustei* Chakravarty et al., 1961 have been kept in the subgenus *Monospiculus* created by Ali in the year 1956.

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