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STUDIES ON VARIATIONS IN AND CONSEQUENT SYSTEMATIC POSITIONS OF VARIOUS INDIAN SPECIES OF *LEPOCREADIOIDES* YAMAGUTI, 1936 (TREMATODA : LEPOCREADIIDAE)*

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INTRODUCTION

The material under study was collected from fish tongue soles (Family Cynoglossidae) from Arabian Sea and Bay of Bengal during various surveys. On detailed study of five populations of *Lepocreadioides* specimens and review of literature on this genus it was felt that intra-specific variations occur due to morphological changes during development from immature to young adults, to full maturity and to aged states. Species have been described based on all such states of development from Indian region under two genera. Consequently, all such species are considered to be one and the same.

Yamaguti (1936) erected the genus *Lepocreadioides* with *L. zebrini* as type species described from a soleid fish *Zebrias zebrinus* (Temm. *et* Schleg.) from East China Seas and the Sea of Japan. The genus is mainly characterised by the marginal position of the genital pore on left side and near oral sucker. The type species is marked by slight crenulations on the margins of hindbody, a median notch at posterior end, a large pharynx, quite wide caeca terminating close to each other at posterior end of body, a club-shaped cirrus sac restricted to left side of oral sucker and pharynx and an oral sucker a little smaller than acetabulum. The second species *L. branchiostegi* was also described by Yamaguti (1938) but from the latilid fish *Branchiostegus japonicus* (Houttuyn) from Hukui Prefecture, Sea of Japan. This species is characterised by rhomboidal or fusiform body shape, uncrenulated body margins, almost equal suckers, the position of ventral sucker being just in front of equatorial level, comparatively small size of pharynx, elongate club-shaped cirrus sac extending obliquely across the left caecum, marked absence of middle notch at posterior end of body, and not as wide caeca as in the type species. The third species *L. orientalis* was

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described by Park (1939) from a soleid fish *Areliscus joyneri* (Guner) from Simmi Island, North Tyosen, Korea. It is characterised by leaf-shaped body with slight crenations on lateral body margins and a median incision at posterior end of body, elongated club-shaped cirrus sac, and narrow caeca terminating a little before posterior end of body. Fischthal and Thomas (1970) described another species *L. cynoglossi* from a tongue sole *Cynoglossus goreensis* Steindachner from Cape Coast and Tema in Ghana. It is characterised by inverted bell or pear shape of body with shoulders on each side of oral sucker, absence of body crenations, trifid posterior end, much elongated testes and narrow intestinal caeca.

Five species have been reported from Indian region i.e., from Arabian Sea and Bay of Bengal. They are : *Lepocreadioides indicum* Srivadtava, 1941, in *Platycephalus insidiator* from the coasts of Puri and Karachi ; subsequently reported by Hafeezullah (1970) and Madhavi (1972) in *Cynoglossus* spp. from Arabian Sea and Bay of Bengal ; *Lepocreadioides srivastavai* Gupta and Mehrotra, 1970, in *Cynoglossus cynoglossus* and *Cynoglossus lingua* from Ernakulum coast, Arabian Sea ; *Lepocreadioides* sp. (Fig. 11) of Karyakarte and Yadav (1976), in *Cynoglossus oligolapis* from Ratnagiri coast, Arabian Sea [this species was not named as all the ten specimens were abnormal and immature (due to non-development of eggs)] ; *Bicaudum otolithi* Bilqees, 1971, in *Otolithus argenteus* from Karachi coast, Arabian Sea ; inadequate and erroneous description due to inadequate material ; *Bicaudum interruptum* Bilqees, 1973, in *Cynoglossus sindensis* from Karachi coast, Arabian Sea ; inadequately described due to insufficient material. Gupta and Govind (1984) described *Lepocreadioides thapari* from the fish *Cynoglossus lida* from Puri coast. It has deeply crenated lateral margins but posterior median incision is lacking. It appears to be a variant of *L. srivastavai* or *L. indicus.*

Qui, Zhang and Li (1987) described the eleventh species *Lepocreadioides huanghuaensis* from a tongue sole *Cynoglossus semilaevis* from Tianjin, China (Bohai Sea). It is characterised by broadly ovate body shape, elongated sausage-like testes, no lateral body crenations and a slight posterior median incision. Pu-qin (1982) described *Lepocreadioides pagrosomi* from the fish *Pagrosomus major* Temmnick and Schlegel from China. It does not fit in the genus *Lepocreadioides* because the genital pore, although marginal on left side, is at level of oesophagus, external seminal vesicle is lacking, ovary is smooth (nonlobate), manner of distribution of vitellaria at caecal ends and very long oesophagus.

Systematic Account

Family : Lepocreadiidae (Odhner, 1905) Nicoll, 1935

Subfamily : Lepocreadiinae Odhner, 1905

Genus **Lepocreadioides** Yamaguti

1936. *Lepocreadioides* **Yamuguti**, *Studies on helminth fauna of Japan. Part 16. Trematodes of fishes, III.* **Published by author** : 1.

1971. *Bicaudum* **Bilqees**, *Paktstan J. Sci.*, **14** (3) : 254.

Lepocreadioides orientalis Park

(Figs. 1-9)

1939. *Lepocreadioides orientalis* **Park**, *Keizo J. Med.*, **10** : 56.

1941. *Lepocreadioides indicus* **Srivastava**, *Indian J. Vet. Sci. Anim. Husb.*, **11** (1) : 52.

1970. *Lepocreadiodes srivastavai* **Gupta and Mehrotra**, *Res. Bull. Panjab Uni.* (*Sci*), **21** (1/2) : 173.

1971. *Bicaudum otolithi* **Bilqees**, *Pakistan J. Sci.*, **14** (13) : 255.

1984. *Lepocreadioides thapari* **Gupta and Govind**, *Indian J. Parasit.*, **8** (1) : 45.

Material examined : Hosts – *Cynoglossus macrolepidotus* (Bleeker), *Cynoglossus bilineatus* (Bloch), *Cynoglossus* sp. and *Cynoglossus lida* (Bloch), Tongue soles, (Family Cynoglossidae) ; location—intestine ; localities—karaikal (Pondicherry), Junput (W. Bengal), Kandla Port, Okha (Gujrat) and Bakkhali (W. Bengal) ; no. of specimen—11 + 10 + 1 + 13 + 11 = 46, on 7 slides.

In view of the wide range of morphological variations exhibited from preadult state to young adult to fully mature to more aged specimens, a reapraisal of the diagnosis of the species is necessitated, which is furnished below :

Description : Body foliate, 1·22-2·94 mm long, 0·58-1·44 mm wide, bluntly pointed anteriorly, broadly rounded posteriorly ; lateral margins smooth in preadult stage, slightly crenated in young adults, becoming more crenated to various degrees and fashions with growing age and maturity so much so that body getting distinctly divided into anterior and posterior halves in old or gravid specimens by deep crenation on each side ; similarly, posterior end may be smooth or a shallow median depression appearing in young adults, becoming deeper and narrow incision or wide notch with growing age. Tegument with minute spines in anterior region. Acetabulum in front of equatorial plane, 0·12-0·196 in diameter. Oral sucker subterminal, 0·08-0·13 long, 0·09-0·19 wide, smaller than acetabulum. Prepharynx short ; pharynx usually smaller than or equal to oral sucker ; oesophagus short, narrow ; intestinal caeca normal in width, simple, ending blindly a little in front of posterior end of body.

Genital pore marginal, near oral sucker on left side ; genital atrium shallow to slightly tubular.

Testes ovate or elliptical, posteguatorial, asymmetrical, intercaecal, on either side of excretory bladder. Cirrus sac club-shaped with elongate neck, obliquely disposed, extending from genital atrium to right side almost in level with anterior margin of acetabulum, enclo-

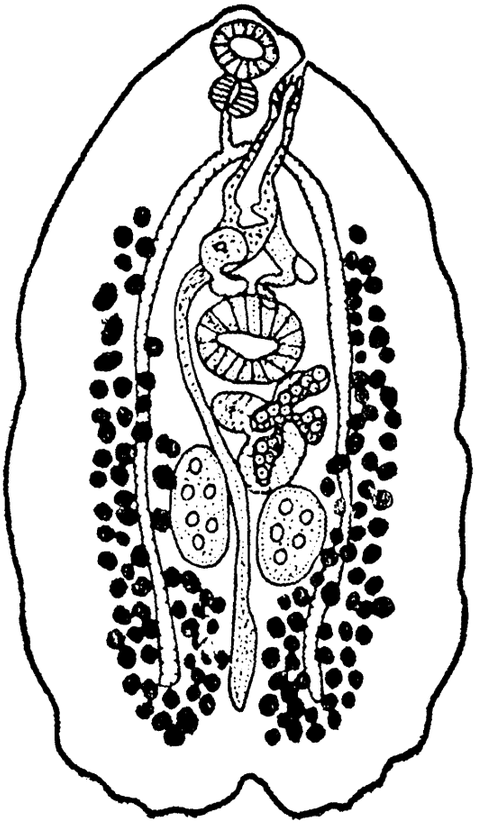

Fig. 1

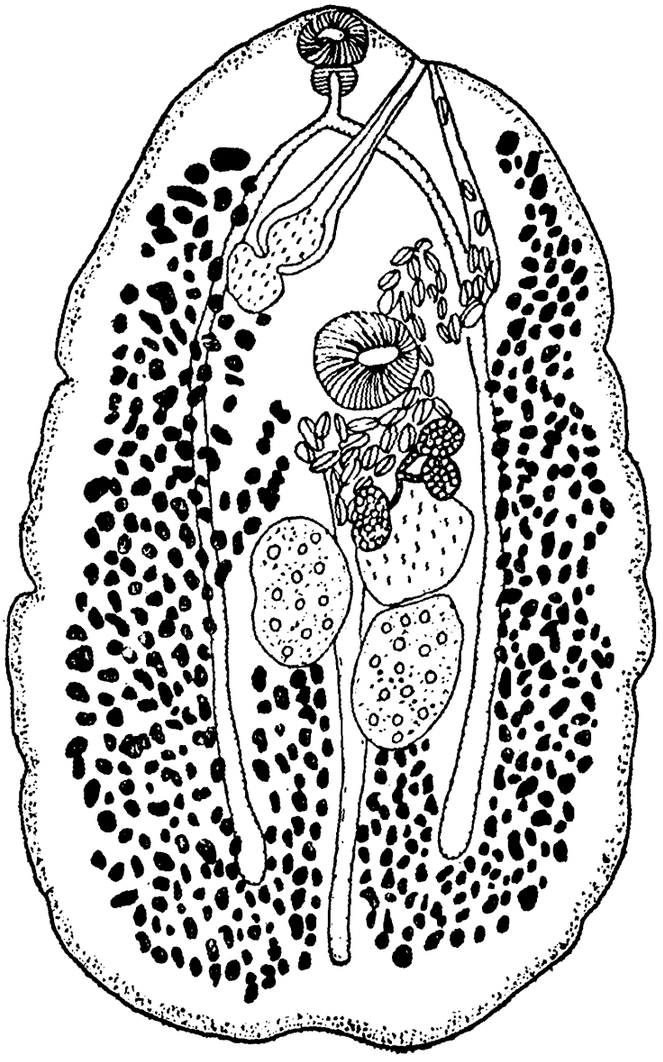

Fig. 2

Fig. 1. *Lepocreadioldes orieutails* Park, 1939 (after Park, 1939).
Fig. 2. *L. orientalis* Park, 1939 (Present material).

sing internal seminal vesicle, pars prostatica surrounded by prostate gland cells, ejaculatory duct and cirrus. External seminal vesicle varying in shape, saccular to tubular, between posterior part of cirrus sac and acetabulum.

Ovary basically 3-lobed, sinistral, in front of posterior testis, lobes joining to knot-like base medially, sublobation occuring occasionally. Uterine coils few, between acetabulum

and testes. Metraterm well developed, with associated metratermal gland cells. Seminal receptacle usually dorsal to ovary, position variable. Laurer's canal present. Vitelline

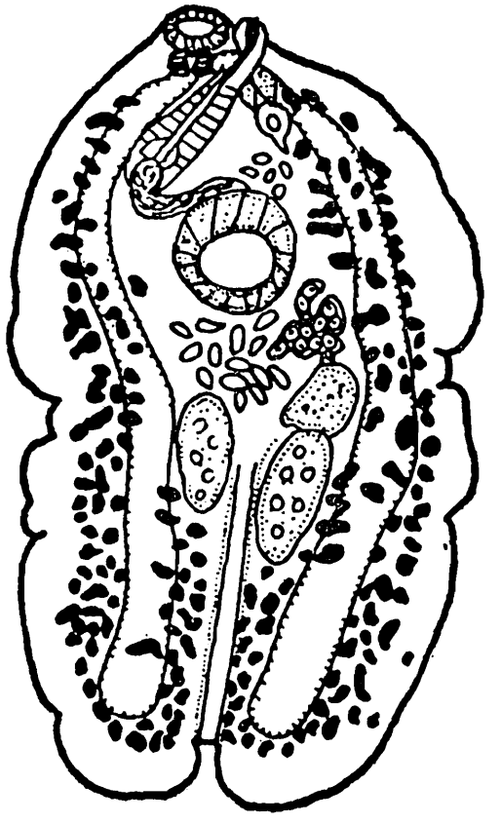

Fig. 3

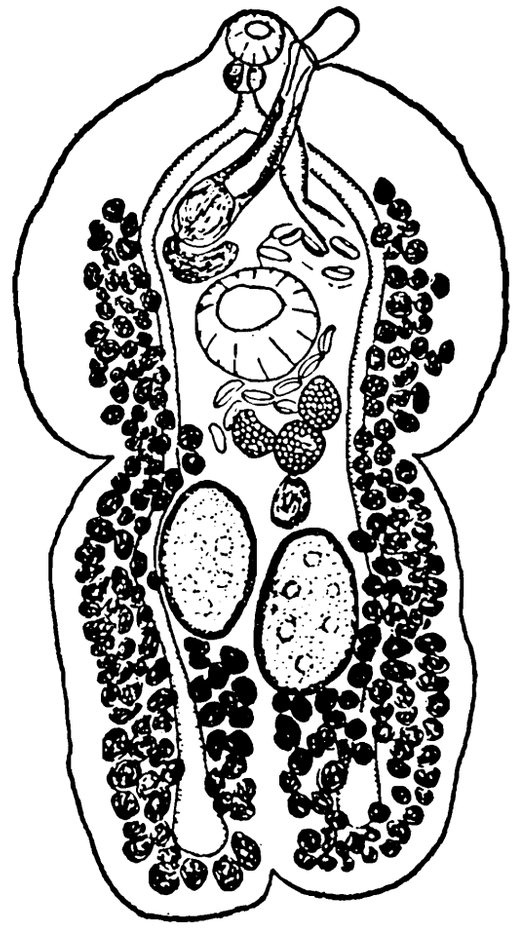

Fig. 4

Fig. 3. *L. indicus* **Srivastava, 1941 (after Srivastava, 1941).**
Fig. 4. *L. indicus* **Srivastava, 1941 (after Hafeezullah, 1970).**

follicles lateral along caeca, anterior limit varying between acetabulum and caecal bifurcation, surrounding caeca posteriorly in posttesticular region. Eggs few, 57-68 × 22-34 μm.

Excretory vesicle tubular, extending beyond acetabulum anteriorly ; excretory pore dorsal in rounded or slightly depressed posterior end, usually at tip of incision in fully mature and aged specimens.

Remarks : The genus *Bicaudum* was erected by Bilquees (1971). It was considered as a synonym of *Lepocreadioides* Yamaguti, 1936 by the senior author (in press) and the type species *B. otolithi* Bilqees, 1971 was synonymised with *L. indicus* Srivastava, 1941, thereby accepting the latter as a valid species. But this position is reviewed as a result of the present study putting the validity of Srivastava's species in question.

In an attempt to prepare a key to the species of the genus *Lepocreadioides*, it was quite possible to separate *L. zebrini*, *L. branchiostegi*, *L. orientalis*, *L. cynoglossi*, *L. interruptum*, and *L. huanghuaensis*, but *L. indicum*, *L. srivastavai* and *L. thapari* were difficult to be separated from Park's species in view of the results of the present study.

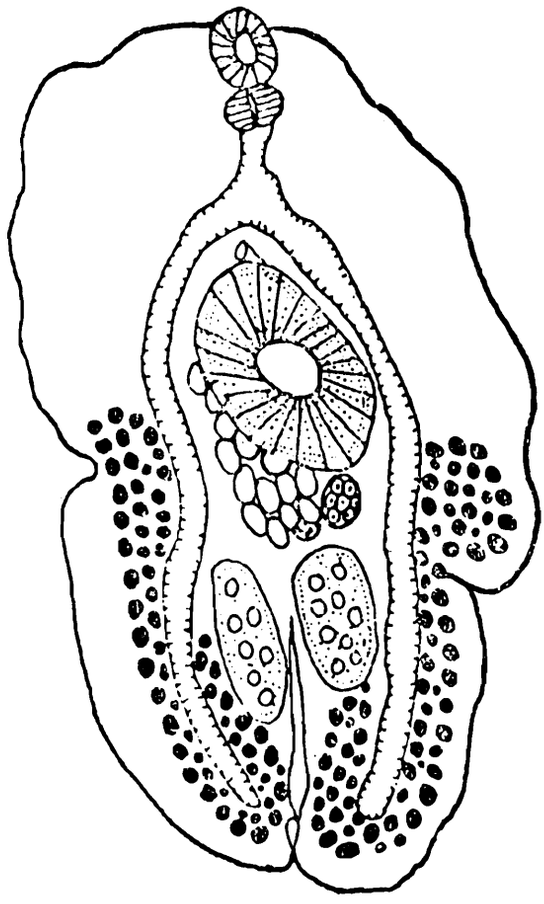

Fig. 5

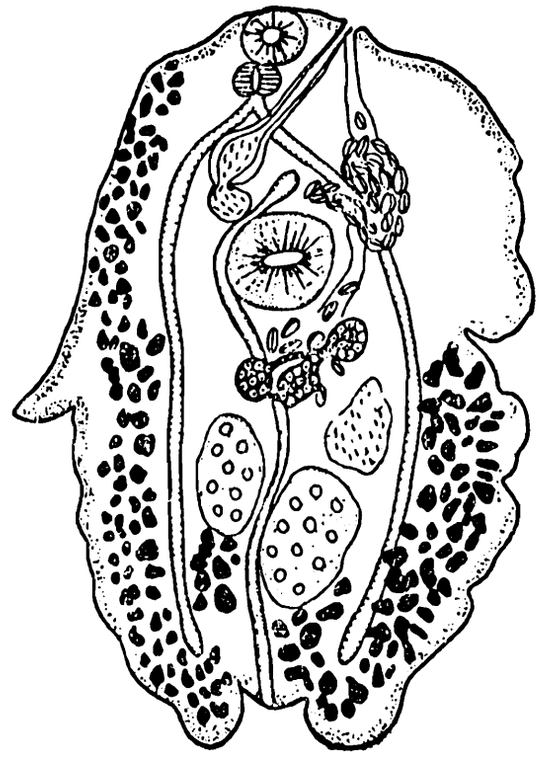

Fig. 6

Fig. 5. *Bicaudum otolthi* **Bilqees, 1971 (after, Bilqees, 1971).**
Fig. 6. *L. orientalis* **Park, 1939 (Present material).**

Lepocreadioides sp. of Karyakarte and Yadav (1976) was excluded from considerations as it has been reported from abnormal and immature specimens. *L. interruptum* (Bilqees, 1973) has been tentatively included in the key on the basis of the reported oral sucker smaller than pharynx, interrupted distribution of vitellaria and a wide and deep median notch at posterior end of body.

Lepocreadioides orientalis, *L. indicum*, *L. srivastavai* and *L. thapari* are closely allied species. They resemble each other not only in shape but also in all other morphological characters, except in absence or presence of body spines and posterior median incision, degree and fashion of lateral marginal crenations and posterior median incision, sublobation

or not of 3 ovarian lobes as well as size nad posiiton of seminal receptacle. The study of present material consisting of 5 populatious (N=46) reveals that the body spines are likely to be shed off during processing of specimens. The degree of lateral crenations is associated with maturity and age of the worm. The basic number of ovarian lobes is 3 and their

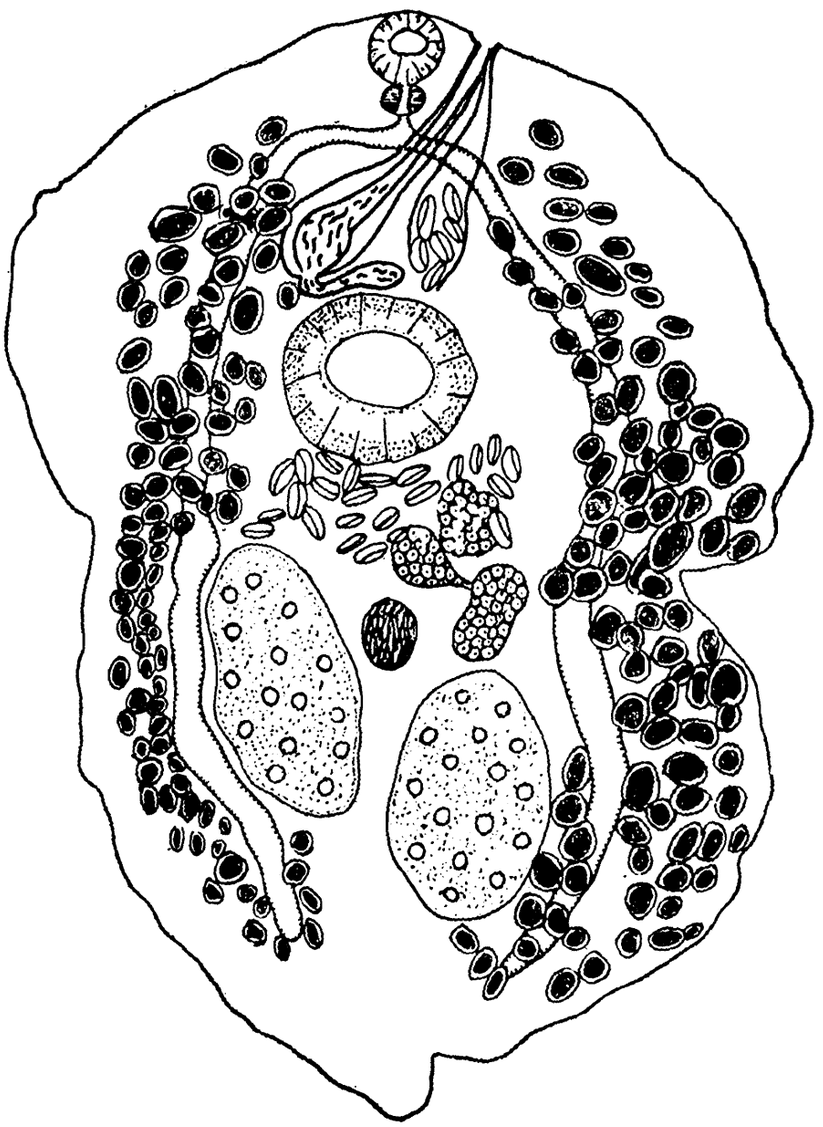

Fig. 7

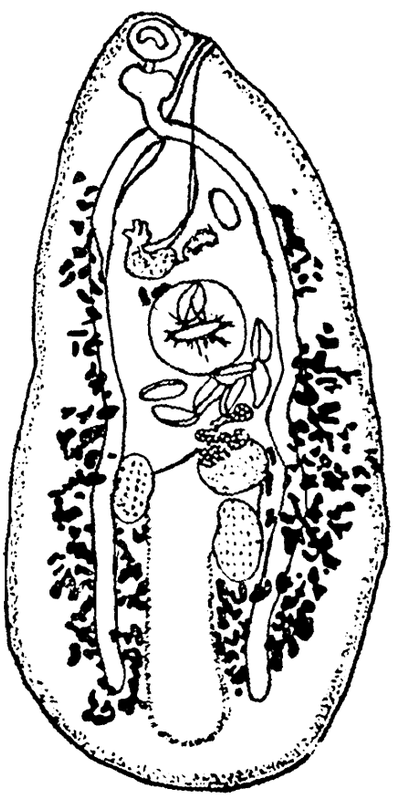

Fig. 8

Fig. 7. *L. orientalis* **Pank, 1939 (Present material).**
Fig. 8. *L. srivastavai* **Gupta and Mehrotra, 1970 (after Gupta and Mehrotra, 1970).**

sublobation is not a reliable character to be used for separating species ; the knot-like root where the 3 basic lobes are joined is not to be counted as an ovarian lobe. Seminal recep-

tacle is a transient structure which may vary in size in various specimens of a population. Moreover, it may occupy varying positions near the ovary in permanent mounts.

The present authors have studied several populations of *Lepocreadioides* specimens, including the present five, collected from various species of tongue soles (family Cynoglossidae) both from east and west coasts of India. A population of such specimens may have all fully mature specimens, while another may have all immature or preadult specimens, or the population may have specimens in various stages of maturity and age. Fully mature specimens may have deeply crenated lateral margins and a median incision or notch at the posterior end of body, both characters in varying degrees, while young adults may not show these characters pronouncedly. Variations in other characters may also be found in varying degrees in the specimens of the same population.

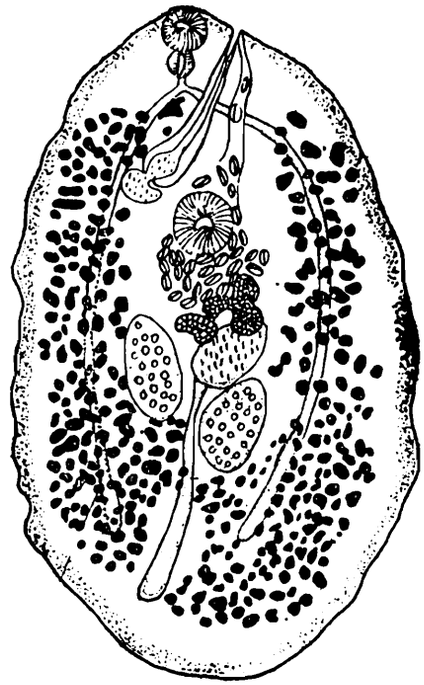

Fig. 9

Fig. 9. *L- orientalis* Park, 1939 (Present material).

Park (1939) described *Lepocreadioides orientalis* from a soleid fish *Areliscus joyneri* (Guner) from Korea on the basis of five specimens. His illustration (Plate VI, fig. 5) shows that the lateral margins are slightly crenated and there is a median incision at the posterior end. Only one or two eggs have been shown in Fig. 5. These features indicate that Park probably had a population of 5 young adult specimens only. Gupta and Mehrotra (1970) described *Lepocreadioides srivastavai* from the tongue soles *Cynoglossus cynoglossus* and *Cynoglossus lingua* from Ernakulum coast on the basis of a population of 3 specimens only. They have noted that the lateral margins are slightly crenated but there is no median incision

at the posterior end of body. Srivastava (1941) described *Lepocreadioides indicum* from the fish ***Platycephalus insidiator*** (family Platycephalidae) and recorded it from the coasts of Puri and Karachi, and subsequently it was reported by Hafeezullah (1970) from *Cynoglossus* spp. (family Cynoglossidae). This species has deeply crenated lateral margins and a deep median incision at the posterior end of body. Hafeezullah's (1970) specimens had deep lateral crenations dividing the body into anterior and posterior regions, as is found in ***Bicaudum otolithi*** Bilqees, 1971. Karyakarte and Yadav (1976) reported *Lepocreadioides* sp. on the basis of a population of 10 immature specimens which were abnormal as far as the dextral

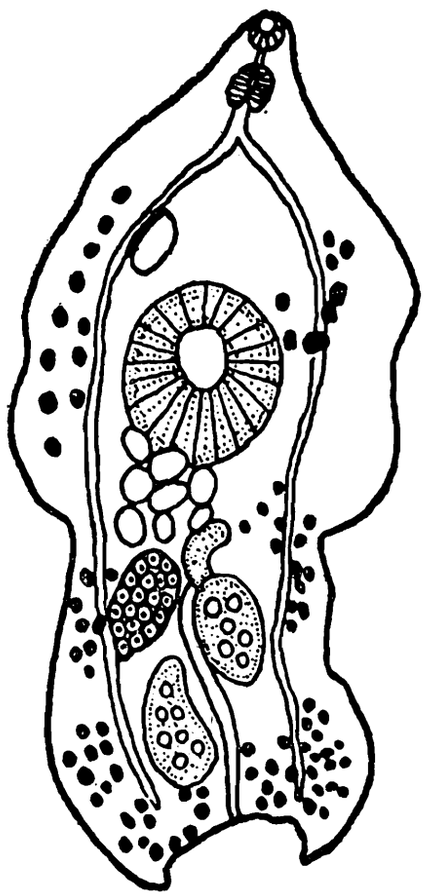

Fig. 10

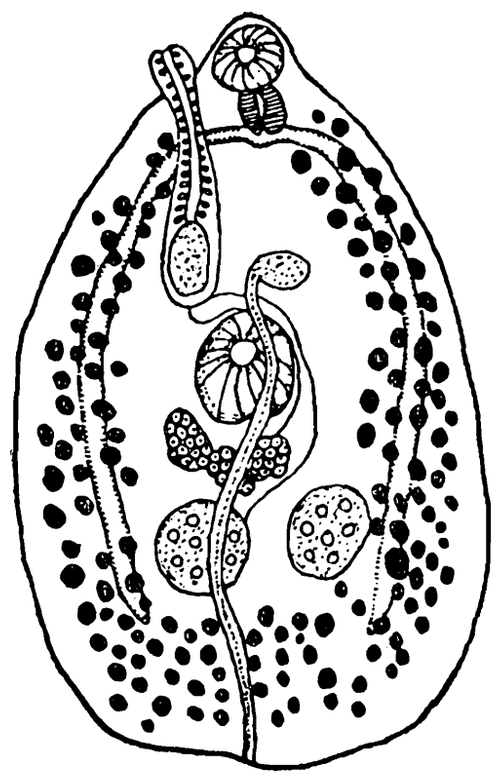

Fig. 11

Fig. 10. *Bicaudum interruptam* Bilqees, 1973 (after Bilqees, 1973).
Fig. 11. *Lepocreadioides* sp. of Karyakarte and Yadav, 1976 (after Karyakarte and Yadav, 1976).

position of genital pore and vertical disposition of cirrus sac are concerned. *L. thapari* occupies an intermediate position between *L. indicum* and *L. srivastavai*.

It is also to be noted that *L. indicum* Srivastava, 1941 and *L. srivastavai* Gupta and Mehrotra, 1970 were not compard with *L. orientalis* Park, 1939 when they were described. The Karaikal (11 worms) and Okha (13 worms) populations, consists of specimens which

are identical to *L. srivastavai* (Fig. 9), *L. orientalis* (Fig. 2) and *L. indicum*. The single specimen from Kandla Port (Fig. 7) has the body divided into anterior and posterior parts by deep lateral crenations. This specimen is exactly like *Bicaudum otolithi* Bilqees, 1971 (Fig. 5) from Karachi except in complete distribution of vitellaria. Of the Bakkhali population (11 worms), one specimen (Fig. 6) is like the previous one from the Kandla Port with the difference that the vitellaria are restricted to posterior half on the left side while its distribution on the right side is normal and complete. The remaining specimens in this population are identical to *L. srivastavai*, *L. orientalis*, *L. indicum* and *L. thapari*. Of the population from Junput (10 worms), most of them are identical to *L. indicum* while one or two are like *L. srivastavai*, and at least one is like *Bicaudum interruptum* Bilqees, 1973 in shape but with oral sucker larger than pharynx and almost uninterrupted vitellaria.

The above evidences should be adequate enough to indicate that *L. srivastavai*, *L. orientalis*, *L. indicum*, *L. thapari* and *L. otolithi* (Bilqees, 1971) intergrade with each other, each representing early adult, young adult, fully mature adult and pretty old or gravid states in succession of one and the same species. *L. srivastavai* and *L. orientalis* represent two young stages while *L. indicum* and *L. thapari* are fully mature state and *L. otolithi* the gravid condition. Other than variations in degree of lateral body crenations and posterior median incision, there are no pronounced morphological differences in these five species. Consequently, by applying the Law of Priority, *Lepocreadioides orientalis* Park, 1939 emerges as the valid species while *L. srivastavai*, *L. indicum*, *L. thapari* and *L. otolithi* fall as its possible synonyms. It may also be emphesised that in the Bay of Bengal and Arabian Sea the favourite hosts of the genus *Lepocreadioides* Yamaguti, 1936 are the tongue soles (family Cynoglossidae) while *Platycephalus insidiator* (family Platycephalidae) and *Otolithus argenteus* (family Sciaenidae) appear to be accidental hosts. *Lepocreadioides interruptum* (Bilqees, 1973) (Fig. 10) is tentatively considered as a valid species in having oral sucker smaller than pharynx, interrupted distribution of vitellaria and a wide median notch at the posterior end of body instead of a narrow incision.

Distribution : Korea, India and Pakistan.

Key to species of genus *Lepocreadioides* Yamaguti

1. Oral sucker distinctly smaller than pharynx ; vitellaria interrupted ...*L. interruptum* (Bilqees, 1973)

   Oral sucker larger than or equal to pharynx ; vitellaria continuous... 2

2. Cirrus sac small, restricted to left of oral sucker and pharynx ; intestinal caeca quite wide terminating close to each other at posterior end of body ... *L. zebrini* Yamaguti, 1936

Cirrus sac long, extending to right side posteriorly near acetabulum ; intestinal caeca narrow, not extending up to posterior end of body ... 3

3. Body shape rhomboidal or fusiform ; no median incision at posterior end of body ...*L. branchiostegi* Yamaguti, 1937

Body shape and posterior end otherwise ... 4

4. Body broadly ovate ; testes elongated sausage-like ...*L huanghuaensis* Qui, Zhang and Li, 1987

Body and testes shapes otherwise ... 5

5. Body inverted bell-or pear-shaped with shoulders on either side of oral sucker ; lateral body margins not crenated ; posterior end of body trifid ; testes elongate oval ... *L. cynoglossi* Fischthal and Thomas, 1970

Body leaf-like ; lateral body margins crenated ; median incision at posterior end of body present ; testes ovate ... *L. orientalis* Park, 1939

SUMMARY

The genus *Bicaudum* Bilqees, 1971 is considered as a synonym of *Lepocreadioides* Yamaguti, 1936. On the basis of study of five populations of *Lepocreadioides* specimens from the intestine of *Cynoglossus* spp. from Arabian Sea and Bay of Bengal, it has been discussed at length that possibly *L. srivastavai*, *L. orientalis*, *L. indicus* and *L. otolithi* represent various gradual states of development and maturity of one and the same species in succession. *L. srivastavai* and *L. orientalis* are two youngest states while *L. indicum* is a fully mature stage and *L. otolithi* the gravid condition. Other than variations in degree of lateral body crenations and posterior median incision or notch, there are no pronounced morphological differences in these four species. Thus, on the basis of Law of Priority, *L. srivastavai*, *L. indicum* and *L. otolithi* are considered as possible synonyms of *L. orientalis*.

Lepocreadioides sp. of Karyakarte and Yadav, 1976 is based on immature and abnormal specimens ; so it has been excluded from consideration. *L. interruptum* (Bilqees, 1973), although based on a single specimen and inadequate and a bit erroneous description, is considered as a valid species. A key to the valid species of the genus *Lepocreadioides* is also furnished.

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