

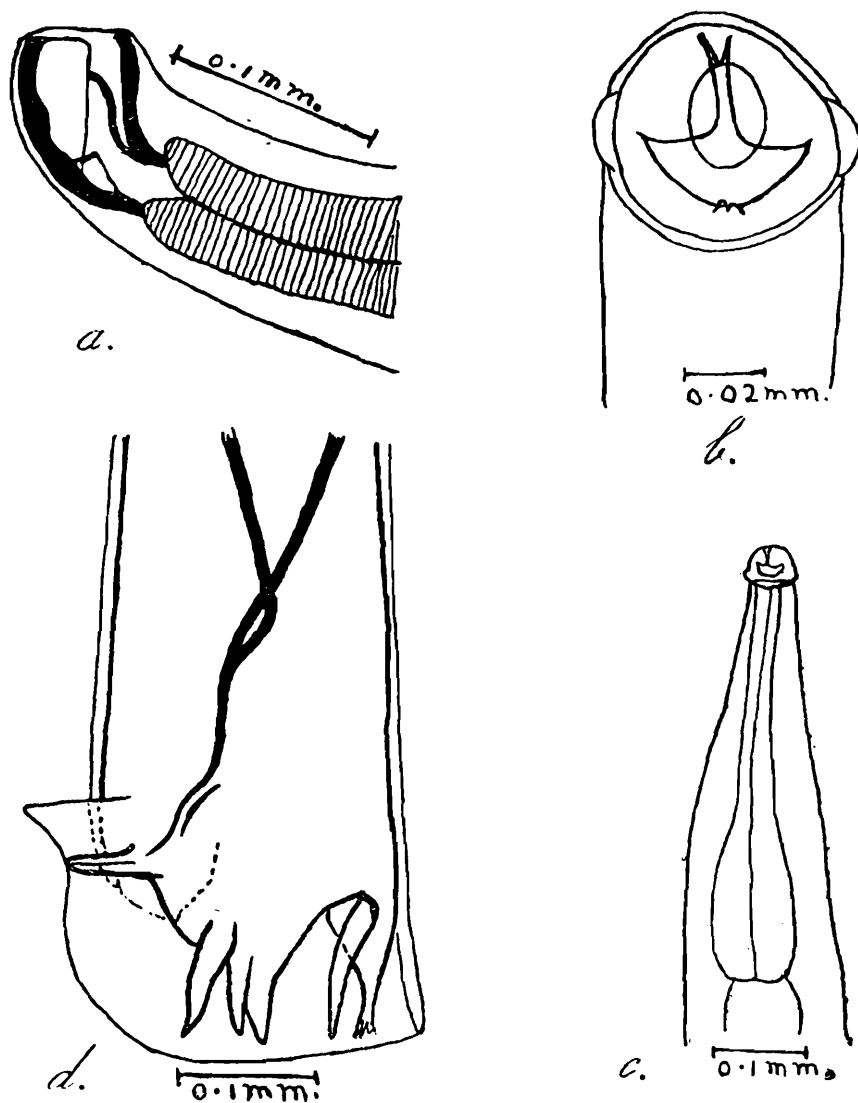
A NEW SPECIES OF *UNCINARIA* FRÖHLICH, 1789 (NEMATODA),
WITH A NOTE ON *U. STENOCEPHALA* (RAILLIET, 1884).

By P. A. MAPLESTONE, D.S.O., D.Sc, M.B., B.Sc., D.T.M.

(From the Helminthological Research Laboratory, School of Tropical Medicine, Calcutta.)

A number of males and females of the species described below were found in a collection of *Ancylostoma braziliense* from the intestine of a leopard cat (*Prionailurus bengalensis*) that died in the Calcutta Zoological Gardens in 1931.

The worms are short and relatively broad and except for the distinct dorsal curve of the anterior end appear quite straight. The buc-



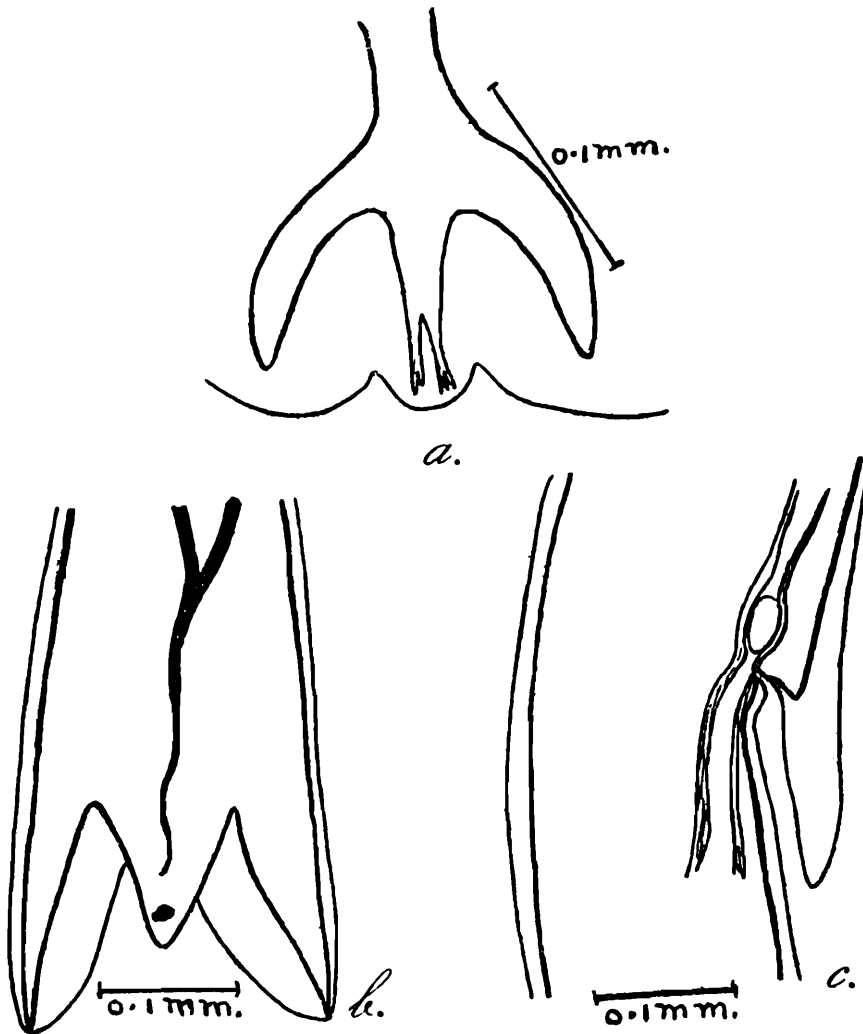
TEXT-FIG. 1. *Uncinaria felidis*, sp. nov.

- a. Anterior end, lateral view, male.
- b. Anterior end, end-on view (dorsal), male.
- c. Anterior end, dorsal view, male.
- d. Posterior end, lateral view, male.

cal capsule, is funnel-shaped, and the anterior opening is guarded by two relatively large right-angled cutting plates, with the angles rounded

off and which extend dorsally covering about two-thirds of the aperture of the mouth capsule (text-fig. 1b). In the depth of the capsule there are a pair of triangular cutting teeth arising from the sub-ventral portion, and there is a curved reinforcing band in the lateral wall of the capsule of greater thickness than the rest of the capsule (text-fig. 1a). The oesophagus is stout and ends in a large distinct bulb. The cervical papillae are short and stout and arise opposite the commencement of the bulbar enlargement of the oesophagus (text-fig. 1c). The excretory pore is marked by a distinct dimple on the convex ventral border just a little behind the level of the cervical papillae.

Male. The bursa is short and its posterior border runs almost straight transversely giving the posterior end of the worm an unusually truncate appearance. The antero-ventral portion of the bursa projects beyond the body of the worm as an angular process when viewed laterally. The rays are typical; the ventral rays are cleft; the lateral rays arise from a common trunk, the externo-lateral being separated



TEXT-FIG. 2. *Uncinaria felidis*, sp. nov.

- a. Dorsal ray, bursa, male.
- b. Genital cone, male.
- c. Region of vulva, female.

from the other two; the externo-dorsal rays are stout and arise from a common trunk with the dorsal; the dorsal rays is divided at its tip and each branch ends in two or three small digitations, the number of

which could not be definitely determined on account of their extreme delicacy (text-figs. 1*d* & 2*a*). There is a relatively long pointed genital cone (text-fig. 2*b*). The spicules converge and finally come together about two-thirds of their length from the proximal end and from there to their tapering tips they lie in contact. This portion is curved in a spiral of about three open turns (text-figs. 1*d* & 2*b*). There is a delicate curved gubernaculum (text-fig. 1*d*).

Female. The vulva lies about the junction of the middle and posterior thirds of the body length, and the opening is covered by an elongate cutaneous flap which arises from its anterior lip and runs posteriorly. The uteri are divergent (text-fig. 2*c*). The tail ends in a sharp point surmounted by a fine cuticular twig.

The genus *Uncinaria* was revised by Baylis¹ in which he gives the salient differential points of the various species, so without repeating these points here it may be said that the present species shows sufficiently distinctive characters to justify its being made a new one. It is accordingly named *Uncinaria felidis*, sp. nov. Host.—*Prionailurus bengalensis* (Kerr).

Habitat.—Intestine.

Table of dimensions in millimetres.

—	Male.	Female.
Length'	3.5-3.7	3.9-4.3
Maximum breadth	0.22	0.26
Cervical papillae from ant. end.	0.30	0.39
Excretory pore from ant. end	0.34	0.34-0.37
Mouth capsule, depth	—	0.72
Mouth capsule, diameter	—	0.55
Oesophagus, length	0.41	0.45-0.47
Spicules, length	0.42-0.45	—
Tail, length	—	0.11
Vulva to tip of tail	—	1.33
Vulval flap, length	—	0.15
Eggs	—	0.055-0.060 × 0.033

¹ Baylis, H. A., *Parasitol.* XXV, p. 308, (1933).

Uncinaria stenocephala (Railliet, 1884).

A number of worms of both sexes taken from the intestine of an Indian ratel (*Mellivora indica*), which died in the Calcutta Zoological Gardens, have been identified as this species. This identification is of interest because, according to Baylis (1936)¹ the only record of *U. stenocephala* in India is that by Gaiger who found the worm in a collection of nematodes at the Punjab Veterinary College, labelled as coming from a dog.

¹ Baylis, H. A., *Faun. Brit. Ind., Nematoda*, Vol. I, p. 337, (1936).

A LIST OF HYMENOPTERA OF SUPERFAMILY CHALCIDOIDEA PARASITES OF CALYPTRATE MUSCOIDEA.

By D. N. ROY, and L. B. SIDDONS, *Department of Medical Entomology,
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The Superfamily Chalcidoidea, recognised by Ashmead as one of the 10 superfamilies of the Order Hymenoptera is, but for a few exceptions, of considerable economic importance, mostly to agriculturists and especially to fruit growers. The Chalcids are genuine parasites destroying injurious species of other orders, attacking their eggs, larvae, and pupae and in some cases even the imagines of their hosts. They are widely distributed almost all over the globe.

Very little is known about their life history, as only the parasites reared from certain hosts have been recorded or described.

During our researches on Muscoids we accidentally came across some fly larvae breeding on a dead snail at Kurseong, Bengal (alt. 4,000 ft.). Eight larvae were collected and later all these pupated. When the adults emerged, they were found to consist of two specimens of *Sarcophaga dux* var. *tuberosa* Pand., and six Hymenoptera of the family Chalcididae. We have also collected further specimens of these parasites from Muscoid puparia.

The species of Chalcids that have been bred by us from Muscoid puparia are :—

Species of Chalcid.	Locality.	Host.
1. <i>Spalangia</i> sp. ¹ (Family Pteromalidae).	Calcutta.	<i>Stomoxys calcitrans.</i> <i>Chrysomyia megacephala.</i> <i>Musca vicina.</i> <i>Sarcophaga</i> sp.
2. <i>Brachymeria fulvitarsis.</i> (Family Chalcididae).	Calcutta.	<i>Chrysomyia megacephala.</i> <i>Sarcophaga ruficornis.</i>
3. <i>Brachymeria argentifrons.</i>	Kurseong (Himalaya). Calcutta.	<i>Sarcophaga dux</i> var. <i>tuberosa</i> , breeding on a dead snail. <i>Sarcophaga dux.</i>
4. <i>Dirhinus pachycerus.</i> (Family Chalcididae).	Kurseong. Calcutta.	<i>Sarcophaga dux</i> var. <i>tuberosa.</i> <i>Sarcophaga ruficornis.</i> <i>Musca inferior.</i> <i>Chrysomyia megacephala.</i>

¹ Previously recorded as parasitising the pupae of *Musca domestica* L. outside India, vide Hewitt, G. C., The House-Fly, *Musca domestica* Linn. (Cambridge, 1914).

Dirhinus pachycerus is the commonest of these parasites, and large numbers of pupae of *S. ruficornis* or *C. megacephala*, if left exposed, are liable to become parasitised by it. The species seems instinctively to collect near the breeding places of these flies.

The species mentioned above have previously been recorded from the following hosts in India.¹

Brachymeria argentifrons Ashmead.

Host—Lasiocampidae.

Locality—S. India.

(Ayyar, 1921.)

Brachymeria fulvitarsis Cameron.

Host—not known.

Locality—Quetta.

(Cameron, 1906.)

Dirhinus pachycerus Masi.

Host—not known.

Locality—Calcutta.

(Masi, 1927.)

The only member of the Chalcidoidea recorded from Muscoidea in this country is :—

Syntomosphyrum indicum Silvestri.

(Family Eulophidae).—Described by Ayyar (1925)² from maggots of an unknown fruit-fly in South India, and by Silvestri (1910) from a fruit-fly at Bangalore.

From the above it will be seen that the Muscoids as hosts of the species of Chalcidoidea mentioned above have not been recorded previously.

The life history of one of the species is being studied in detail.

Our thanks are due to Dr. Ferriere and to Sir Guy Marshall for the identification of the specimens.

¹ Vide Mani, M. S.—*Catalogue of Indian Insects*, Pt. 23, Chalcidoidea (Delhi, 1938).

² Ayyar, T. V. R.—*Spol. Zeyl.* XIII, p. 252 (1925).

OBSERVATIONS ON THE BIONOMICS OF THE MIDGE *CHIRONOMUS* (*LIMNOCHIRONOMUS*) *TENUIFORCEPS* (KIEFF.) OCCURRING ON THE FILTER-BEDS OF THE CALCUTTA CORPORATION WATER WORKS AT PULTA, NEAR CALCUTTA (CHIRONOMIDAE : DIPTERA).

By H. A. HAFIZ, Ph.D. (London), D.I.C. (London), Assistant Superintendent, Zoological Survey of India, Calcutta.

INTRODUCTION.

Chironomus (*Limnochironomus*) *tenuiforceps* (Kieff.)¹ is by far the most abundant of the several species of Chironomidae occurring in the slow sand filter-beds in the water works of the Calcutta Corporation at Pulta. The "mound-shaped" larval and pupal cases of this species, which are found spread almost uniformly over the surface layer of the filter-beds, appear to interfere, to some extent, with the process of filtration, and it was, therefore, considered desirable to study the bionomics of this Chironomid in connection with the investigations on the biology of the slow-sand filter-beds at Pulta which are being carried out by the Zoological Survey of India. Unfortunately, very few observations have been made on the bionomics of any species of Chironomidae in India; the only reference being that of *C. cubiculorum* Dolesch² Rempel's³ account of the life-history of the North American species, *C. hyperboreus* Staeger, is unfortunately too brief for comparative purposes. In this species eggs, which are said to be deposited over the lake surface, sink to the bottom. Four larval instars and a two-year life-cycle were observed.

I am grateful to Mr. F. W. Edwards, British Museum, London, for kindly identifying the adult midges and to Dr. B. Prashad, Director, Zoological Survey of India, for helping me in preparing this paper for the press. The text-figures illustrating this paper were prepared under my supervision by Babu S. C. Mondul, one of the artists of the Zoological Survey of India.

OBSERVATIONS.

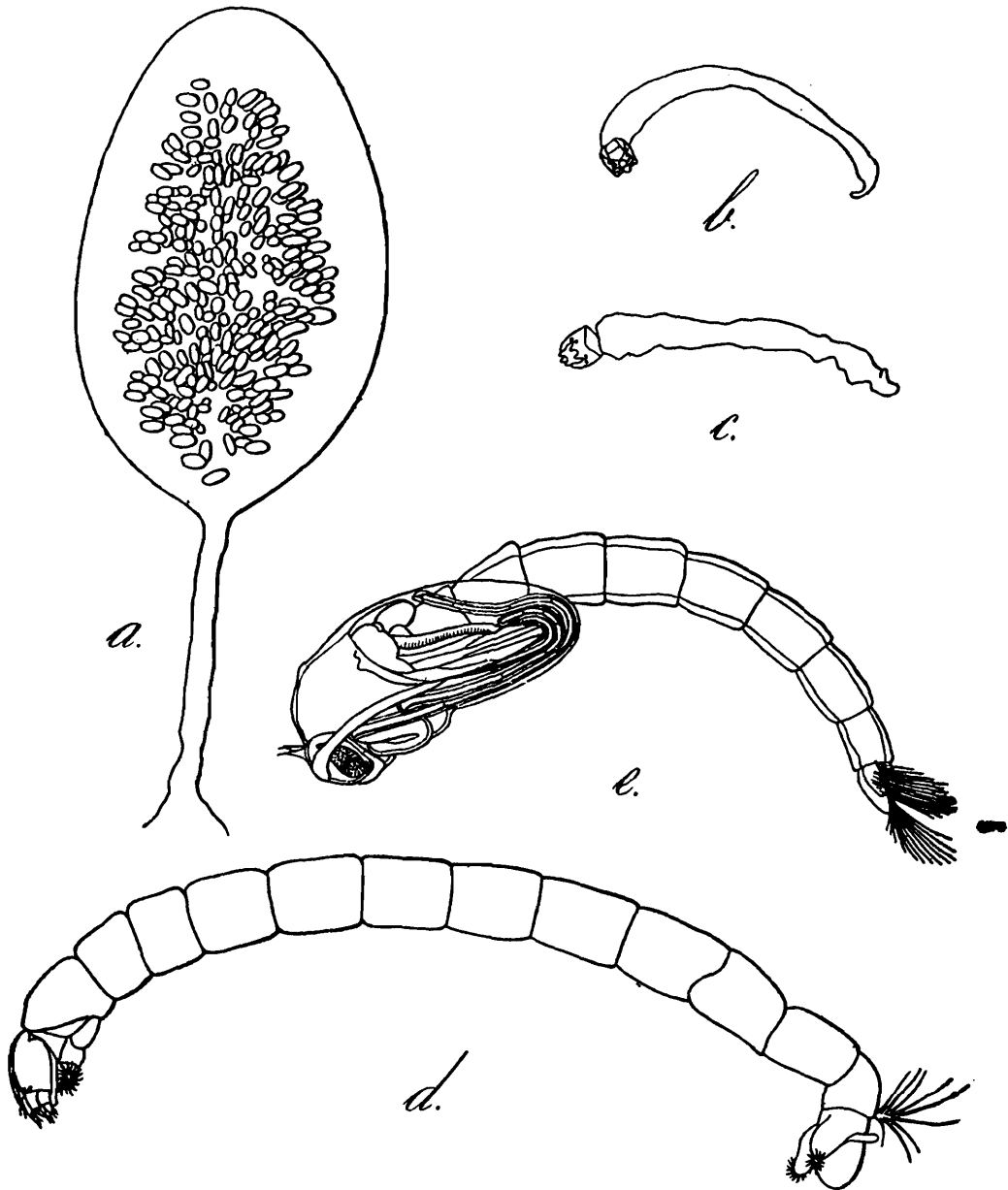
Eggs of this species are laid in water embedded in pear-shaped gelatinous masses which are moored to the surface layer of the filter-beds by short stalks (text-fig. a). Each mass consists of several hundred eggs, narrowly elliptical in shape and of a milky-white colour, which are collected together in the middle in an irregular manner. The colour of the eggs changes to pale-brownish after about two days. Each egg is, on an average, 0.2 mm. long. Thread-like colourless larvae hatch out, in the laboratory, about four days after oviposition. It is not

¹ Kieffer, J. J., *Ann. Soc. Sci. Bruxelles*, p. 166, (1919).

² *Ind. Mus. Notes* V, p. 189, (1903).

³ Rempel, J. G., *Journ. Biol. Board of Canada* II, p. 209, (1936).

possible to make out the segments of the larva at this stage. A two-days old larva is 0.88 mm. long (text-fig. *b*). A figure of a first larval



Chironomus (Limnochironomus) tenuisforceps (Kieff.).

a. Egg-mass, drawn from a photograph, $\times 11$; *b.* A two-days old larva, drawn from slide, $\times 36$; *c.* Cast skin of first instar, drawn from slide, $\times 36$; *d.* Lateral view of full-grown larva, $\times 14.5$; *e.* Lateral view of pupa, $\times 14.5$.

cast skin is also given (text-fig. *c*). After about a week the larvae turn light greenish and later become red (text-fig. *d*); by this time they grow to a length of 8 mm.

So far it has not been possible to make a detailed study of the life-history of these midges with regard to the number of instars, as it was not found possible to keep very young segregated larvae alive, under laboratory conditions, beyond a few days. From observations made in the field, however, it appears that full grown larvae when ready to pupate are about 8 mm. in length. The period of pupation appears to last for three to four days and the number of days taken for the life-cycle to be completed does not appear to exceed about twenty days.

Soon after hatching out of the eggs, the Chironomid larvae surround themselves with very thin tubes which are of the same length as the

larvae. The body of the larvae lies entirely in these tubes but the head is constantly pushed out in search of food and more material for enlarging the tubes. The tube is formed of minute grains of sand, bits of dead algae, silt, etc., which are cemented together by the silk-like secretion of the salivary glands of the larvae.

With the increase of thickness of the tube, the length of the tube is also increased by the addition of more material to the open end of the tube by the larva. From time to time the larva completely withdraws itself inside the tube, where it sets up characteristic lashing movements of the body. It was also noticed that as the length of the tube increases, the tubes sometimes become rather curved in outline. This condition was observed on several occasions on the surface of an affected filter-bed when the water had been drained off for scraping and cleaning.

It is not unusual for the larva to pierce the roof of its tube at various points to pick up more bits of material for increasing the thickness of the wall of the tube. Sometimes the larva abandons its tube and swims about freely for a while in the water, but before long it builds a fresh tube or enters one abandoned by another larva. Larvae that are accidentally buried in sand to a depth of an inch or more are unable to crawl through to the surface, and ultimately perish.

As the time for pupation approaches, the larva gradually closes the open end of the tube, and lies fully stretched, but the undulating movements of the body, referred to above, are continuously maintained. To all intents and purposes, the tube now becomes a temporary grave for the pupating larva.

The pupa is usually devoid of all colour in the region immediately behind the thorax, but the anterior and posterior ends still retain the reddish brown colour. The pupa is about 5.6 mm. in length, and has a considerably broader and more rounded head than the larva (text-fig. e). It is doubled up in the form of a broad U. The body movements are very rapid, the head and the tail ends moving at the same time.

The amount of space needed for the pupa in the original narrow larval tube is possibly attained by stretching the elastic walls of the tube with what appears to be the powerful pounding action of the head and the tail ends of the pupa against the wall of the tubes. The pupae are unable to repair any damage or to re-enter the tubes when dislodged or build new pupal tubes. The pupa finally comes out of its tube by making a neat hole by its head near the anterior end of the pupal tube. It then lies on the sand still keeping up its body movement. When it is more or less ready for the emergence of the adult, it comes up to the surface of water and remains there with its head at the surface, and the rest of the body hanging down into the water in almost a straight line. From time to time, however, it dives down into mid-water. When the pupa is finally ready for passing into the adult stage it rises again to the surface of water, remains there for a few seconds with its bent head-end protruding slightly above the surface, and after what appears to be a desperate struggle, the head emerges first and the body later and the adult fly then rests on the thin empty floating pupal skin, till the wings are unfolded and dried when it flies off.

Besides the "mound-shaped" type of larval and pupal tubes made by the species of Chironomidae dealt with in this paper, a "cylindrical" type of tubes of the larvae and pupae of *Chironomus* (s. str.) *barbatitarsis* (Kieff.) and *Chironomus* (*Cryptochironomus*) *orissae* (Kieff.)¹ also occurs on the filter-beds. The former type of tubes is, however, the most important in so far as the filter-beds are concerned in that it occurs in enormous numbers uniformly spread over almost the entire surface of the bed; sometimes as many as 800 larvae occur in an area of one square foot. The "cylindrical" tubes on the other hand are less numerous than the "mound-shaped" tubes and they do not completely cover up the surface layer. The majority of these tubes lie loosely on the surface of the filter-beds and are very rarely attached to each other in any numbers. Further, their tubes appear to be rather thinner and probably more porous.

From the following table it will be seen that the Chironomid larvae and pupae which make the "mound-shaped" tubes generally occur during the months of December, January, February and the early part of March. During the remaining months of the year, the "cylindrical" type of larval and pupal tubes occurs in great abundance. Sometimes a few of these also occur along with the "mound-shaped" tubes but, as remarked above, they are never so abundant as the "mound-shaped" tubes.

Years and months.	Types of Chironomid larval and pupal tubes.
1937.	
January	"Mound-shaped" tubes and a few "cylindrical" tubes.
February (early)	"Mound-shaped" tubes and a few "cylindrical" tubes.
March (early)	"Mound-shaped" tubes and a few "cylindrical" tubes.
March (late)	"Cylindrical" tubes.
April	"Cylindrical" tubes.
May	"Cylindrical" tubes (a few).
June	"Cylindrical" tubes.
July	"Cylindrical" tubes.
August	"Cylindrical" tubes (a few).
September	"Cylindrical" tubes.
October	"Cylindrical" tubes.
November	"Cylindrical" tubes.
December	"Mound-shaped" and a few "cylindrical" tubes.

¹ Kieffer, J. J., *Rec. Ind. Mus.* IX, p. 131, (1913).

Years and months.			Types of Chironomid larval and pupal tubes.
1938.			
January	..	..	"Mound-shaped" tubes.
February	..	..	"Mound-shaped" tubes.
March	..	..	*
April	..	..	"Cylindrical" tubes.
May	..	..	"Cylindrical" tubes.
June	..	..	"Cylindrical" tubes.
July	..	..	"Cylindrical" tubes.
August	..	..	"Cylindrical" tubes (a few).
September	..	..	"Cylindrical" tubes (a few).
October			*
November	..	..	"Cylindrical" tubes.
December	..	..	*
1939.			
January	..		"Mound-shaped" tubes.
February	..		"Mound-shaped" tubes.
March (early)	..	..	"Mound-shaped" tubes.
March (late)	..	..	"Cylindrical" tubes.
April	..		"Cylindrical" tubes.
May	..	..	"Cylindrical" tubes.
June	..	..	"Cylindrical" tubes.
July	..		"Cylindrical" tubes.

* No observations are available for these months.

I have observed several instances of earwigs preying on female Chironomid flies near the edge of the water, but they do not occur in sufficient numbers to serve as a natural biological check on the latter.

Removal of grass and other weeds in the neighbourhood of the filter-beds among which newly emerged Chironomid flies rest during the hot part of the day before mating and laying eggs, has to a certain extent reduced the number of these flies. De Meillon and Gray¹ in a recent paper have observed that the increase of salinity of water has proved of value for controlling the number of a South African species of *Chironomus* Meig. For obvious reasons, this method cannot be applied in the case of filter-beds which supply water for human consumption.

¹ De Meillon, B. and Gray, F. C., *S. Afr. Med. J.* XI, pp. 658-660, (1937).

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ON SOME INDIAN TORTRICIDAE (LEPIDOPTERA).

By A. DIAKONOFF, *Amsterdam, Netherlands.*

(3rd Communication on Indo-Malayan and Papuan Microlepidoptera.)

By the courtesy of Mr. J. C. M. Gardner, Systematic Entomologist of the Forest Research Institute, Dehra Dun, I received a small collection of Tortricidae from that Institute, for identification. As all specimens have been bred and bear notes on the foodplants, I think it worth while to give a list of them. The species concerned show striking polyphagous habits.

***Epagoge retractana* Wlk.**

U. P. Dehra Dun, New Forest. 12 and 26. viii. 1933 ; 24. ix. 1934. Larvae on *Chrysanthemum* and *Acacia arabica* (R. N. Mathur). 3 ♀.

***Adoxophyes privatana* Wlk.**

Madras, Nilambur, Amarampalam R. 29. iv. 1933. Larvae on *Glycomis pentaphylla* (C. F. C. Beeson). 1 ♀.

***Homona coffearia* Nietn.**

U. P. Dehra Dun, New Forest ; Madras, Nilambur, Nilambur Range. 16. iv. 1933 ; 12. xi. 1936. Larvae on *Eugenia jambolana* (R. N. Mathur, C. F. C. Beeson). 2 ♀.

***Cacoecia micacaeana* Wlk.**

This is a difficult species to deal with, because of its variability in colouring, especially in the male and of a certain plasticity in the wing-shape. Meyrick used the shape of the forewings as a specific character and described some species, which prove to be simply varieties of one and the same species, *C. micacaeana* Wlk. In the present lot three forms are represented, rather differing in colouring and wing shape. Nevertheless I regard them as belonging to the same species, because the genital apparatus is identical and the shape and markings in forewings show gradual transitions from one to another. The extremes, however, lie so far from each other, that a description of these varieties is justified.

***C. micacaeana* Wlk. *obscura*, var. nov.**

♂. 18 mm. Head and palpi dark brown. Thorax dark greyish-brown. Abdomen greyish, with anal tuft ochreous. Forewings rather elongate, with narrow base, distinctly dilated posteriorly, costa anteriorly gradually arched, posteriorly gradually sinuate, prominent. Costal fold from base to nearly 2/5. Dark-brown towards costa and base, suffused brownish-pink on dorsum before tornus. Central fascia ill-defined,

except for its narrow origin below costal fold, dark ferrugineous-brown, its lower $2/3$ represented by rounded brownish-pink suffusion in disc and in the middle of dorsum, being light lilac-brownish, its tornal $1/5$ lighter, ochreous, with a lilac tinge. Basal marking and costal patch dark ferrugineous-brown, the latter very elongate, reaching from $2/5$ to $5/6$ of wing. The curved transverse streak from beneath costal patch before termen often connected with the lower end of a streak from apex along termen, in this way a dark ferrugineous-brown y-shaped figure being formed before termen. Hindwings light-ochreous, with dorsum and apex grey.

U. P., Dehra Dun, New Forest, Kandauli; Haripur Haldwani. 6, 10 and 19. ii; 4 and 27. iv; 3. xii; 1934-1937. (A. K. Sharma, R. N. Mathur, N. C. Chatterjee). Larvae on *Eugenia jambolana*, *Lantana* fruits and seeds, *Millettia auriculata*. 6 ♂.

Type in British Museum. Paratypes in the Forest Institute and in the author's collection.

C. micacaeana Wlk. forma **typica**.

U. P., Dehra Dun, New Forest; Bindal; Dharampur; Kandauli; near Rispana, Kandauli. 27. iv., 16 and 31. v, 19 and 28. vi, 22 and 31. vii, 17, 22 and 31. viii, 17, 22, 24-25. ix, 12. x., 30. xi, 8. xii 1930-1937. Larvae on *Acacia arabica*, *Albizia procera*, *Aster*, *Cosmos*, *Gmelina arborea*, *Lantana* flowers, fruits, leaves, *Michelia champaca*, *Santalum album*, *Terminalia tomentosa*. (R. N. Mathur, N. C. Chatterjee, G. D. Bhasin). 3 ♂, 16 ♀.

The typical *micacaeana*-male (of which *C. epicyrta* Meyr. is a synonym) is the intermediate form, of which an elaborate description is given in the *Journal of Bombay Nat. Hist. Society*, Vol. XVI, p. 589 (1905), after specimens from Ceylon. I have seen this form also from Sumatra and Java.

Cacoecia micacaeana Wlk. var. **compacta** (Meyr.) Diak.

U. P., Dehra Dun, New Forest; Bindal. 21-22. vi, 10 and 30. vii, 3, 12, 14 and 26. viii, 3, xii. 1933-36. Larvae on *Aster*, *Cassia fistula*, *Chrysanthemum*, *Lantana* fruits, *Mallotus philippinensis*, *Mangifera indica*, *Morus alba*, *Santalum album*. 9 ♂.

The following is a description of the female of this variety.

♀. 17 mm. Head ochreous, suffusedly mixed with ferrugineous. Palpi ochreous. Thorax ochreous mixed with ferrugineous. Abdomen brownish-ochreous. Forewings scarcely expanded posteriorly, costa anteriorly strongly but gradually arched, posteriorly slightly sinuate, with apex curved and prominent towards termen, termen sharply sinuate below apex, rounded and prominent beneath. Light ochreous-brownish with a pink-lilac shine. A few irregular ill-defined transverse strigulae, becoming darker before termen and elongate-semioval costal patch dark ferrugineous. Cilia dark ferrugineous along termen, blackish-brown at apex and light ochreous around termen. Hindwings ochreous-orange, with dorsal third greyish.

U. P., Dehra Dun, New Forest, 5. v. 1937 (R. N. Mathur). 1 ♀. Type in British Museum.

The three forms above-mentioned may be distinguished as follows : colouring : var. *obscura* : dark-violet tinged, pink suffusion in disc and base, very long and narrow costal patch ; forma *typica* : ochreous, with brownish markings, costal patch much shorter and broader ; var. *compacta* : light reddish-ferrugineous, costal patch moderate ; form of forewings : var. *obscura* : forewings narrow and elongate, costa sinuate apex projecting ; forma *typica* : forewings moderate, costa sinuate apex projecting ; var. *compacta* : ♂ forewings short, truncate, costa little sinuate, apex rounded-prominent, ♀ forewings with costa little sinuate.

***Cacoecia micacaeana* Wlk. var. *machlopis* (Meyr.) Diak.**

U. P. Dehra Dun, Bindal. 19. i. 1937. Larvae on *Lantana* fruits (N. C. Chatterjee). 1 ♀.

In his description Meyrick says : “ Allied to *epicyrta* but with all curves of forewings exaggerated ” ; *machlopis* was described after ♀ specimens from Assam, Khasi Hills and Java (Bandong) ; this variety is larger than the typical form of *micacaeana*.

***Cacoecia micacaeana* Wlk. var.**

U. P., Haripur, Haldwani, Dehra Dun, New Forest, 12. ii., 3. v, 21. viii. 1936-1937. Larvae on *Mangifera indica*, *Morus Indica*, *Lantana* fruits (N. C. Chatterjee, R. N. Mathur). 1 ♂, 2 ♀.

It was not possible to state with certainty to which variety these three specimens belong, because of their bad condition.

NOTE.—I have dealt with the synonymy of several species of *Cacoecia* in my paper “ The Genera of Indo-Malayan and Papuan Tortricidae ”, now in press in *Zoologische Mededeelingen Mus., Leiden* (1939).

***Cacoecia pomivora* Meyr.**

U. P., Dehra Dun, New Forest. 14. viii. 1933. Larvae on *Acacia arabica* (R. N. Mathur).

***Ulodemis trigrapha* Meyr.**

U. P., Dehra Dun, Dharampur. 9. x. 1933 ; 21. vii. 1937. Larvae on *Lantana* leaves and flowers (N. C. Chatterjee). 1 ♂, 1 ♀.

SUMMARY.

The foodplants and localities are given for 6 species of Indian Tortricidae. Five varieties of *Cacoecia micacaeana* Wlk. are characterised including *obscura*, var. nov.

CYCLOPIDES (CRUSTACÉS COPÉPODES) DE L'INDE.

II. UNE REVISION DES REPRÉSENTANTS INDIENS DU SOUS-GENRE *MICROCYCLOPS* CLAUS, DU GENRE *CYCLOPS* MÜLLER.

Par KNUT LINDBERG.

INTRODUCTION.

Pendant ces dernières années j'ai pu récolter dans des localités différentes de la péninsule indienne un assez grand nombre de spécimens appartenant au sous-genre *Microcyclops* Claus. Parmi eux il s'est trouvé 8 formes distinctes, la description de 7 d'entre elles ayant déjà été publiée ou se trouve en voie de publication. Les animaux qui ont servi à ces descriptions ont cependant été en nombre très réduit et originaires d'une seule localité ou d'une région circonscrite. Le matériel qui s'offre maintenant à l'étude étant beaucoup plus complet rend nécessaire une redescription, du moins partielle, de certaines de ces formes et permet une vue d'ensemble sur ce groupe avec l'établissement d'une clef d'identification.

Bien que la variabilité des contours du réceptacle séminal est considérable, sa structure présente chez les animaux indiens, de même que chez ceux d'Europe, deux aspects principaux : celui du type *bicolor*, chez lequel les sacs sont disposés transversalement, et celui du type *varicans*, qui, en plus de bras transversaux, possède une partie de direction verticale. Aussi les espèces étudiées ici se rangent dans ces deux groupes et d'autre part le nombre d'articles de la première antenne, que j'ai jusqu'à ce jour trouvé constant chez les spécimens indiens, offre un second terme de classification facile à observer.

Tous les spécimens qui ont servi à cette étude ont été récoltés par moi-même, sauf ceux de Nagpou, de Tchanda et du lac Himayat à Haïdérabad, qui ont été pêchés par mon assistant, le médecin indigène, Dr. George Daniel.

Je donnerai maintenant la liste des formes connues avec leurs caractères principaux, récapitulés aussi brièvement que possible, leurs habitats et des notes complémentaires quand la nécessité d'en donner se présente.

I. *Cyclops (Microcyclops) karvei* Kiefer et Moorthy.

Femelle, sauf réceptacle séminal et sacs ovigères, décrite par Kiefer et Moorthy en 1935 ; mâle, et détails manquant sur la femelle, décrits par l'auteur en 1939.

Première antenne à 9 articles. Furca à branches parallèles de 2.6 à 2.8 fois aussi longues que larges. Peu de différence entre la longueur de la soie apicale externe de la furca et celle de la soie apicale interne. Cinquième patte à article court, sans épine et sans prominence sur le rebord interne. Réceptacle séminal du type *varicans*. Mâle environ

560 μ . Sixième patte rudimentaire formée d'une petite épine interne, d'une fine soie médiane légèrement plus longue et d'une soie externe atteignant le bord postérieur du deuxième segment abdominal.

Habitats.—Etang artificiel à Tchitaldrug, Etat de Maïsore (Moorthy) ; réservoir à Ellora (Etat de Haïdéradab) ; rivière Krichna à Sangli (Pays des Mahrattes du Sud).

II. *Cyclops (Microcyclops) diminutus* Lindberg.

Femelle décrite en 1937. Mâle encore inconnu. Première antenne à 10 articles. Branches de la furca très légèrement divergentes, de 2.6 à 3.1 fois aussi longues que larges. Soie apicale interne 2 fois aussi longue que la soie apicale externe. Article terminal de l'enp. 4 environ

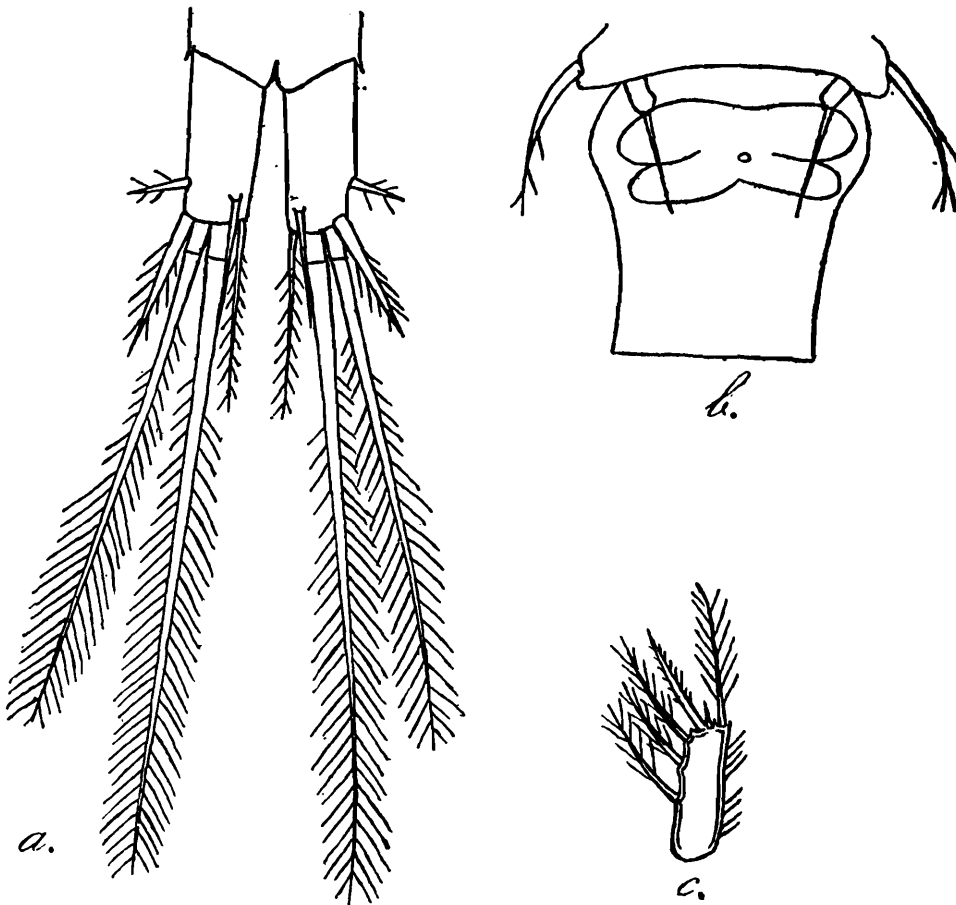


FIG. 1. *Cyclops (Microcyclops) diminutus* Lindberg.

a. ♀ Furca (Bassein) ; b. ♀ Cinquième patte et segment génital (Bassein) ; c. ♀ Article terminal de l'enp. 4. (Bassein).

2.5 à 3 fois plus long que large. Epine apicale interne de cet article de 2 à 3 fois aussi longue que l'épine apicale externe.

Longueur de l'épine apicale interne le plus souvent environ la moitié, de celle de l'article qui la porte. Cinquième patte à article court, sans épine, mais à prominence du rebord interne. Réceptacle séminal du type *bicolor*.

Habitats.—Etang à Cansaulim (Goa, Inde portugaise) ; rivière à Danoli (Etat de Savantvadi) ; rivière près du lac Povaï (Ile de Salsette) ; citerne délabrée à Bassein (sur la côte au nord de Bombay).

III. *Cyclops (Microcyclops) moghulensis* Lindberg.

Description de la femelle sous presse. Première antenne à 10 articles. Furca, à branches parallèles, un peu plus de 3 fois aussi longues que larges. Peu de différence de longueur entre la soie apicale interne et la soie apicale externe. Article terminal de l'enp. 4 plus de 2 fois aussi long que large. Epine apicale interne 2 fois plus longue que l'épine apicale externe. La longueur de l'article surpasse celle de l'épine apicale interne d'environ un quart. Article de la cinquième patte assez allongé, sans épine et sans prominence notable sur le rebord interne. Réceptacle séminal du type *varicans*. Mâle inconnu.

Habitat.—Citerne près des grottes d'Ellora (Etat de Haïdérabad).

IV. *Cyclops (Microcyclops) tricolor* Lindberg.

Femelle décrite en 1937. Première antenne à 11 articles. Branches de la furca nettement divergentes, environ 3 fois aussi longues que larges (rapports de 2.78 : 1 à 3.75 : 1). Soie apicale interne environ 2 fois aussi longue que la soie apicale externe. Article terminal de l'enp. 4 en moyenne de 2.5 fois aussi long que large. Epine apicale

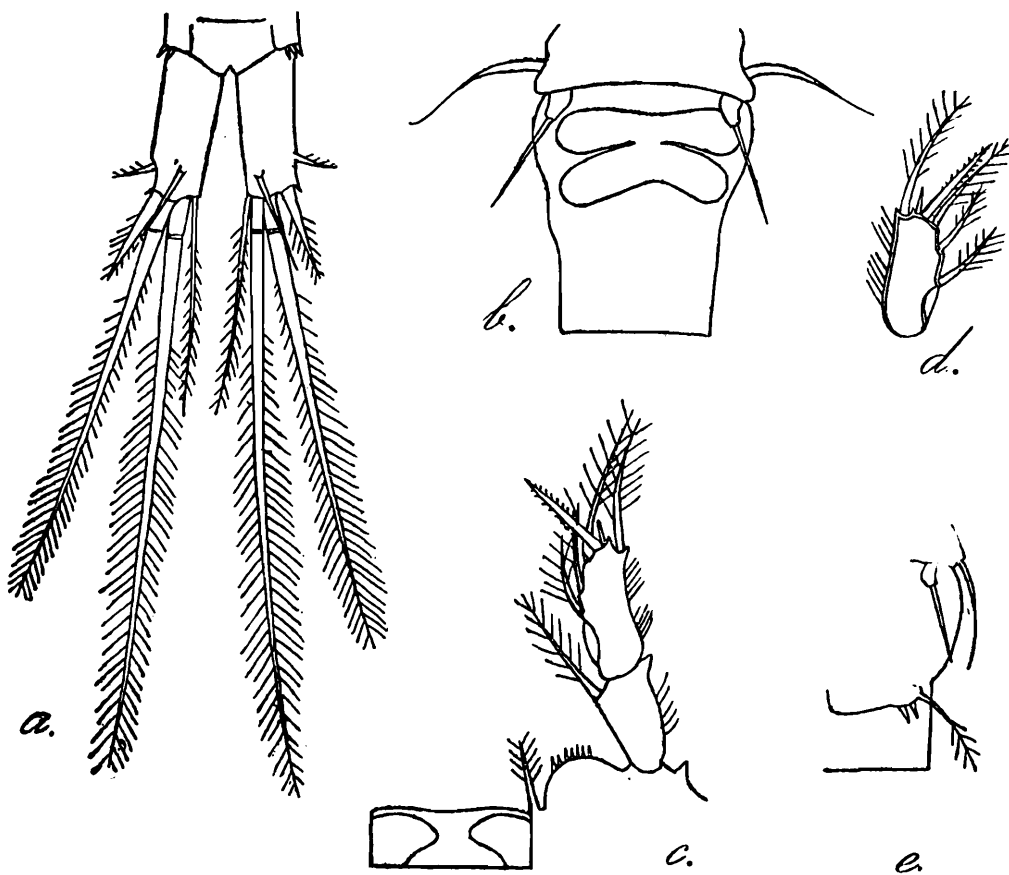


FIG. 2. *Cyclops (Microcyclops) tricolor* Lindberg.

a. ♀ Furca (Ellora); b. ♀ Cinquième patte et segment génital (Ellora); c. ♀ Endopodite de la quatrième paire de pattes et lamelle basale (Ellora); d. ♀ Article terminal de l'enp. 4 (Pandharpour); e. ♂ Cinquième et sixième pattes (Pandharpour).

interne en moyenne de 3.3 fois plus longue que l'épine apicale externe. Rapport entre la longueur de l'article terminal de l'enp. 4 et celle de l'épine apicale interne en moyenne de 1.35 : 1.

Cinquième patte à article court, sans épine mais à prominence sur le rebord interne. Ovisacs pouvant contenir jusqu' à 22 oeufs, le plus souvent ne renfermant que de 6 à 10 oeufs, assez gros. Réceptacle séminal du type *bicolor*. Mâle plus petit, longueur 500 μ ; sixième patte rudimentaire composée d'une petite épine interne, d'une soie médiane, qui lui égale à peu près en longueur et d'une fine soie ciliée, assez longue, atteignant le rebord postérieur du deuxième segment abdominal.

Habitats.—Rivière près de Nadiad; étang à Djogechvari (Ile de Salsette); rivière près du lac Povaï (Ile de Salsette); étang à Elephanta (Port de Bombay); citerne d'irrigation, réservoir, ruisseau à Ellora (Etat de Haïdérahad); étang des blanchisseurs et puits abandonné envahi par la jacinthe d'eau à Kouldabad (Etat de Haïdérahad); étang temporaire à Latour (Etat de Haïdérahad); petite mare et grand réservoir de Mir Alam à Haïdérahad; rivière de Gharipouri (près Barsi); carrière abandonnée, petite mare, puits et rivière Bhima à Pandharpour; étang à Arkonam (présidence de Madras); étang et mare temporaire à Villenour (Inde française); étang du Jardin Colonial à Pondichéry; lac à Ootacamund (montagnes Nilghiris).

V. *Cyclops (Microcyclops) indo-lusitanus* Lindberg.

Femelle décrite en 1938. Première antenne à 11 articles. Branches de la furca divergentes, 3 fois aussi longues que larges. Soie apicale interne 2 fois aussi longue que la soie apicale externe. Deuxième article de l'endopodite de la quatrième paire de pattes 2.5 fois aussi long que large. Epine apicale interne environ 3 fois aussi longue que l'épine apicale externe; elle est considérablement plus courte que l'article qui la porte. Article de la cinquième patte assez allongé, sans épine. Réceptacle séminal du type *varicans*. Mâle inconnu.

Habitat.—Citerne délabrée à Bassein.

VI. *Cyclops (Microcyclops) varicans* Sars.

Syn. C. (M.) varicans var. *pachyspina* Lindberg.

Après avoir découvert dans un étang à Goa (Inde portugaise) 4 femelles appartenant à l'espèce *C. (M.) varicans* Sars, mais montrant un deuxième article de l'enp. 4 très allongé (plus de 3 fois aussi long que large), et l'épine apicale interne de cet article à base renflée, rappelant l'aspect d'un bulbe d'oignon, j'ai distingué cette forme sous le nom de *C. (M.) varicans* var. *pachyspina*.

A cette époque-là je n'avais pas encore eu l'occasion d'étudier d'autres exemplaires indiens de l'espèce *M. varicans*.

Pendant ces dernières années je me suis rendu compte que le *M. varicans*, sans doute le *Microcyclops* le plus commun de l'Inde, tout en présentant des caractères définis dans la structure de la furca et de ses appendices offre des variations notables en ce qui concerne la configuration du deuxième article de l'enp. 4 et des épines apicales, ces

variations étant très grandes surtout dans le rapport entre la longueur et la largeur de l'article terminal. Cet article reste cependant le plus souvent plus allongé que chez le *M. varicans*, tel qu'il a été décrit en Europe, mais les spécimens chez lesquels cet article a été de plus de 3 fois aussi long que large se sont montrés assez rares. Vu l'analogie que présente autrement la variété décrite sous le nom de *M. varicans pachyspina* (forme à article terminal de lenp. 4 de plus de 3 fois aussi long que large) avec les autres représentants indiens de l'espèce *M. varicans*, je considère comme résultat de l'étude du matériel présent, comprenant une centaine d'échantillons de plus de 20 localités et d'environ 40 habitats différents, que la distinction de cette variété n'est plus justifiée, d'autant plus qu'elle se trouve reliée à l'espèce typique par des formes de passage. Le *C. (M.) varicans*, tel qu'on le rencontre dans l'Inde offre par conséquent les caractères principaux suivants.

Espèce assez grande et robuste. Longueur de la femelle de 700 à 900 μ (sans les soies apicales). Première antenne à 12 articles. Branches de la furca en général parallèles, de 3 à 4 fois aussi longues que larges. Rapport moyen entre la longueur de la soie apicale interne et celle de la soie apicale externe de la furca de 1.38 : 1. Article terminal de l'enp. 4 le plus souvent moins de 3 fois aussi long que large,

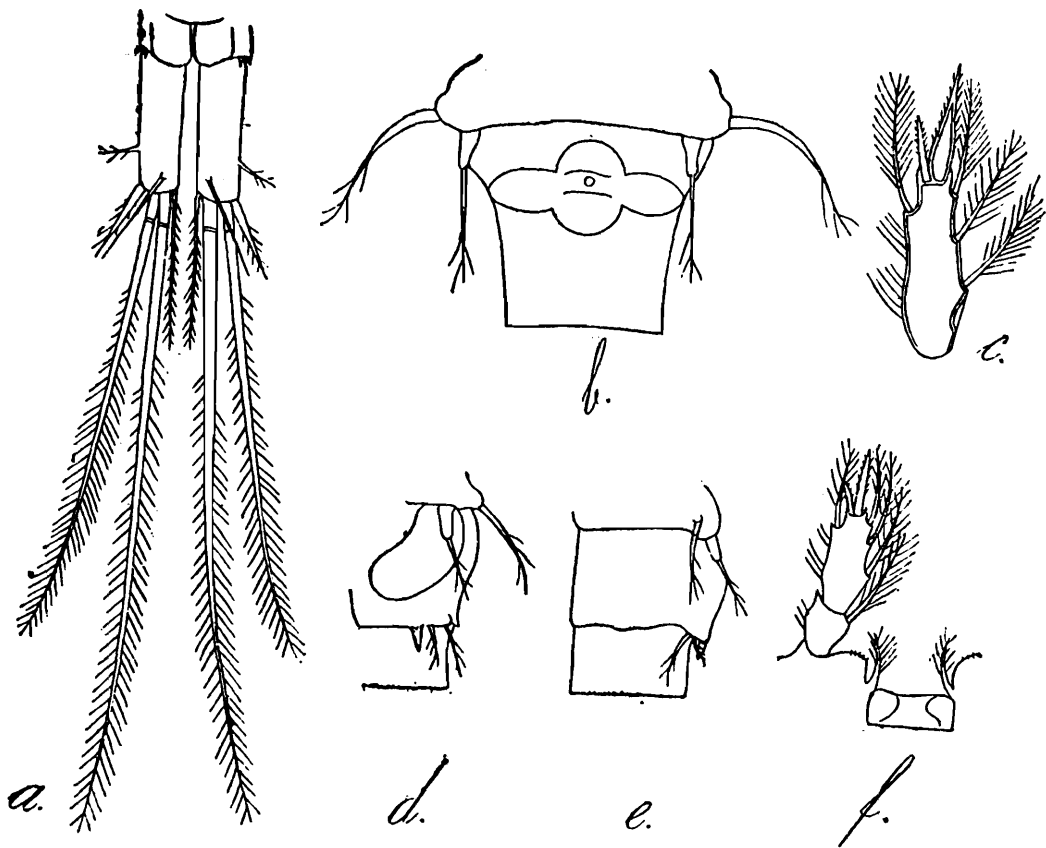


FIG. 3. *Cyclops (Microcyclops) varicans* Sars.

a. ♀ Furca (Pondichéry); b. ♀ Cinquième patte et segment génital (Pondichéry); c. ♀ Article terminal de l'enp. 4 (Pondichéry); d., e. ♂ Cinquième et sixième pattes (Pandharpour); f. ♂ Endopodite de la quatrième paire de pattes et lamelle basale (Pandharpour).

mais offrant de grandes variations. Epine apicale interne plus ou moins élargie dans sa partie proximale. Rapport entre la longueur de l'épine apicale interne et celle de l'épine apicale externe en moyenne de 1.69 : 1 ;

celui entre la longueur de l'article et celle de l'épine apicale interne de 1.60 : 1. Article de la cinquième patte allongé, environ 3 fois aussi long que large. Il est presque toujours dépourvu d'épine, mais des exemplaires munis d'une petite épine bien distincte, située sur le rebord interne un peu plus près de l'extrémité que de la base, se rencontrent quelquefois. Réceptacle séminal offrant certaines variations, mais répondant dans les grandes lignes à un type défini. Ovisacs en général très grands, dépassant la furca, pouvant contenir chacun jusqu' à 34 œufs. Mâle, longueur de 500 à 700 μ . Branches de la furca parallèles, de 2.5 à 3.5 fois aussi longues que larges. Cinquième patte à article un peu moins allongé que chez la femelle. Sixième patte rudimentaire composée d'une forte et courte épine interne, d'une soie médiane, le plus souvent un peu plus longue que l'épine et d'une soie externe qui

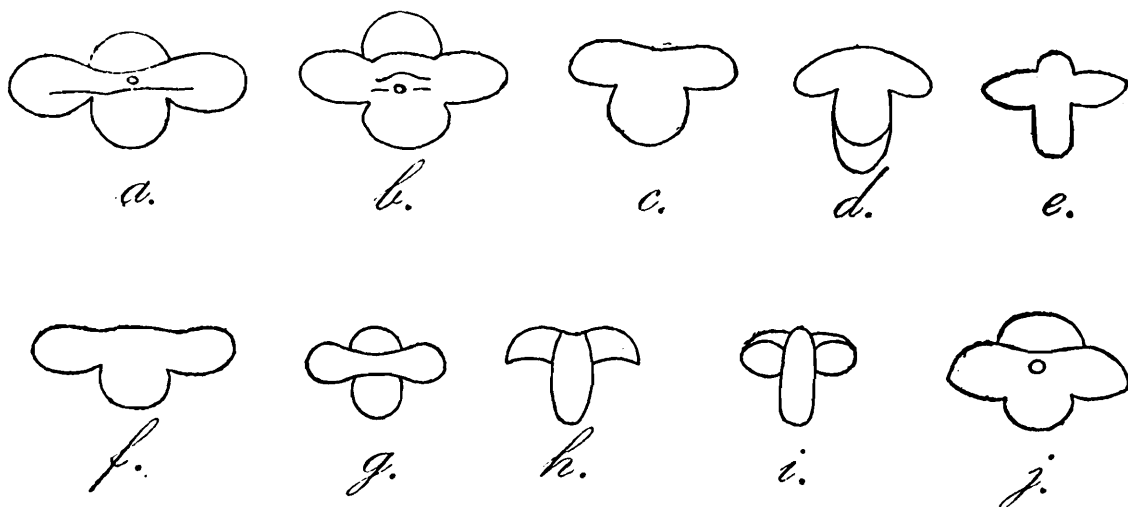


FIG. 4. *Cyclops (Microcyclops) varicans* Sars., Réceptacle séminal.

a. Aurangabad ; b. Pandharpour, c., d., e. Gharipouri (Barsi) ; f. Ootacamund ; g. Ghatkopar (Bombay) ; h. Danoli (Savantvadi) ; i., j. Cansaulim (Goa).

atteint ou dépasse un peu le bord postérieur du deuxième segment abdominal. Rebord postérieur du deuxième, troisième et quatrième segments abdominaux découpé sur les aspects ventraux et latéraux en petites dents indistinctes. Une dentelure semblable peut aussi se distinguer chez la femelle au niveau du deuxième et troisième segments abdominaux, mais y est encore plus indistincte que chez le mâle.

Habitats.—Nagpour (Provinces Centrales), étang ; Tchanda (Provinces Centrales), étang (♂ seulement) ; Nadiad, rivière ; Ellora, citerne, réservoir ; Aurangabad, mare de rivière ; Haïdérabad, puits, réservoir Mir Alam, lac Himayat ; Elephanta (Ile du port de Bombay), étangs, citernes ; Lac Povai (Ile de Salsette), rivière, étang ; Ghatkopar (Ile de Salsette), rivière ; Lonavla, mare de rivière ; Karli, étang ; Malavli, étang ; Gharipouri (près Barsi), rivière, mare ; Mahisgaon (près Kurduvadi), rivière Sina ; Pandharpour, rivière Takli, réservoir, puits, rivière Bhima, étangs, mares ; Danoli (Etat de Savantvadi), rivières et mares ; Vengurla, mare ; Cansaulim (Goa), étangs, fosse ; Pondichéry, petite rivière, étang du Jardin colonial ; Villenour (Inde française), étang ; Ootacamund (montagnes Nilghiris), lac ; Kodaikanal (montagnes Palni), lac, bassin près d'une chute d'eau.

VII. Cyclops (Microcyclops) varicans var. **subaequalis** (Kiefer).Syn. C. (*M.*) *subaequalis* Kiefer.

Dans quelques localités j'ai trouvé des animaux qui semblaient identiques à *M. varicans*, sauf dans la structure de l'épine apicale interne de l'article terminal de l'enp. 4, celle-ci ne présentant pas de renflement de sa partie basale et étant le plus souvent un peu plus allongée par rapport à l'article que chez le *M. varicans*. La soie apicale interne de la furca était chez ces mêmes spécimens plus longue par rapport à la longueur de la soie apicale externe que chez le *M. varicans*. De plus, chez tous les exemplaires de ce type, l'article de la cinquième patte portait une petite épine sur le rebord interne.

Bien que les mensurations ne se conformaient pas tout à fait à celles données par Kiefer pour le *M. subaequalis*, il me semble que les différences sont trop faibles pour qu'il soit permis de séparer ces deux formes sous des noms différents.

D'autre part il faut rappeler que le *M. subaequalis* avait été distingué par Kiefer à une époque quand cet auteur ne connaissait pas encore l'existence de formes de passage quant au rapport entre la longueur de l'article terminal de l'enp. 4 et celle de l'épine apicale interne, Kiefer ayant donné un rapport variant entre 1.7 : 1 et 1.9 : 1 pour le *M. varicans* et entre 1.07 : 1 et 1.3 : 1 pour le *M. subaequalis*. Après avoir rencontré des spécimens de Madagascar et de la Palestine chez lesquels ce rapport s'est montré être de 1.4 : 1 à 1.5 : 1, Kiefer a lui-même exprimé des doutes sur la validité du *M. subaequalis* comme espèce distincte, mais Kiefer a encore maintenu la distinction de cette " espèce " en attendant que des recherches futures donneront plus de lumière sur la question.

La similarité entre ces deux formes est du reste si frappante qu' il me semble beaucoup plus logique de distinguer le *M. subaequalis*, non comme une espèce séparée du *M. varicans*, mais comme en étant une variété proche. Qu' il soit réellement distincte au point de vue génétique est évidemment une autre question, qui ne peut pas être résolue à présent.

Le matériel qui s'offre maintenant montre que la plupart des animaux étudiés de l'Inde se rapprochent des spécimens de Kiefer de Madagascar et de la Palestine, mais que chez les exemplaires ayant l'épine apicale interne de l'article terminal de l'enp. 4 à partie proximale étroite, le rapport entre la longueur de cette épine et celle de l'article est en général considérablement plus petit, c'est-à-dire la différence de longueur entre celle de l'article et celle de l'épine interne est bien moindre chez le *M. varicans* var. *subaequalis* que chez le *M. varicans* forme typique, celle-ci ayant une épine interne plus courte par rapport à la longueur de l'article.

Le *M. varicans* var. *subaequalis* tel qu'il est connu de l'Inde montre par conséquent les caractères suivants.

Longueur de la femelle adulte 750 μ à 900 μ . Première antenne à 12 articles. Branches de la furca parallèles de 3.22 à 4.61 fois aussi longues que larges (moyenne 3.85 : 1). Rapport entre la soie apicale

interne et la soie apicale externe de la furca en moyenne de 1.63 : 1. Article terminal de l'enp. 4 en général d'environ 2.3 fois plus long que large. Epine apicale interne allongée sans élargissement dans sa partie

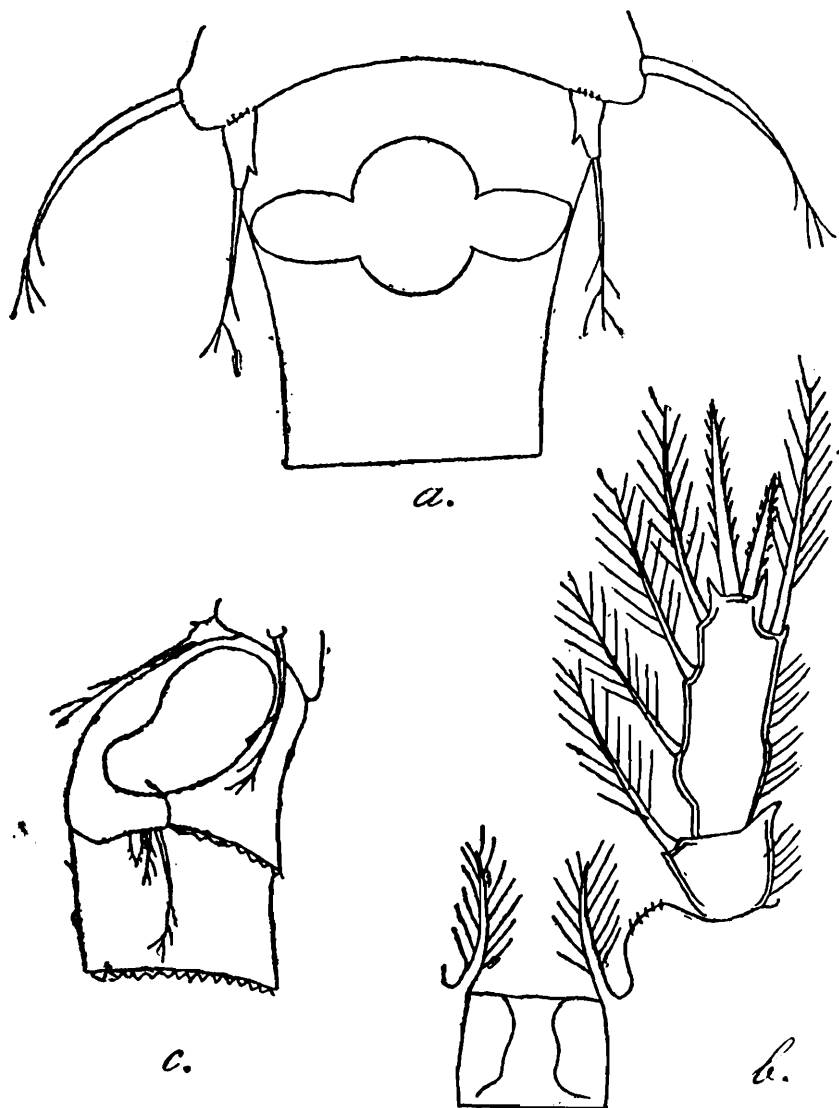


FIG. 5. *Cyclops (Microcyclops) varicans* var. *subaequalis* (Kiefer).

a. ♀ Cinquième patte et segment génital (Pandharpour); b. ♀ Endopodite de la quatrième paire de pattes et lamelle basale (Pandharpour); c. ♂ Cinquième et sixième pattes (Pandharpour).

proximale. Rapport entre la longueur de l'épine apicale interne et celle de l'épine apicale externe en moyenne de 1.76 : 1 ; ce qui revient à dire que l'épine apicale interne est légèrement plus longue par rapport à la longueur de l'épine apicale externe chez la variété *subaequalis* que chez le *M. varicans* forma typica. Rapport moyen entre la longueur de l'article et celle de l'épine apicale interne de 1.33 : 1. Article de la cinquième patte allongé, comme chez le *M. varicans* typique, mais portant toujours (autant qu'il soit connu) une petite épine sur le rebord interne. Réceptacle séminal et ovisacs semblables à ceux de l'espèce typique. Mâle (un seul exemplaire). Longueur 608 μ . Sixième patte rudimentaire formée d'une forte épine interne, d'une soie médiane lui surpassant un peu en longueur et d'une soie externe atteignant le bord postérieur du deuxième segment abdominal.

Habitats.—Ellora (Etat de Haïdérabad), ruisseau, réservoir ; Ramling (près Barsi), mare ; Pandharpour, rivière Takli, étang.

VIII. *Cyclops (Microcyclops) davidi* var. *subtropicus* Lindberg.

Syn. *C. (M.) subtropicus* Lindberg.

J'ai décrit en 1937 sous le nom de *M. subtropicus*, d'après quelques exemplaires récoltés dans l'Ile de Salsette, une forme qui m'a aussitôt frappé comme offrant des analogies avec le *M. davidi* Chappuis. Ces quelques spécimens montraient cependant certaines différences dans la structure de la furca, de l'article terminal de l'enp. 4, de la cinquième

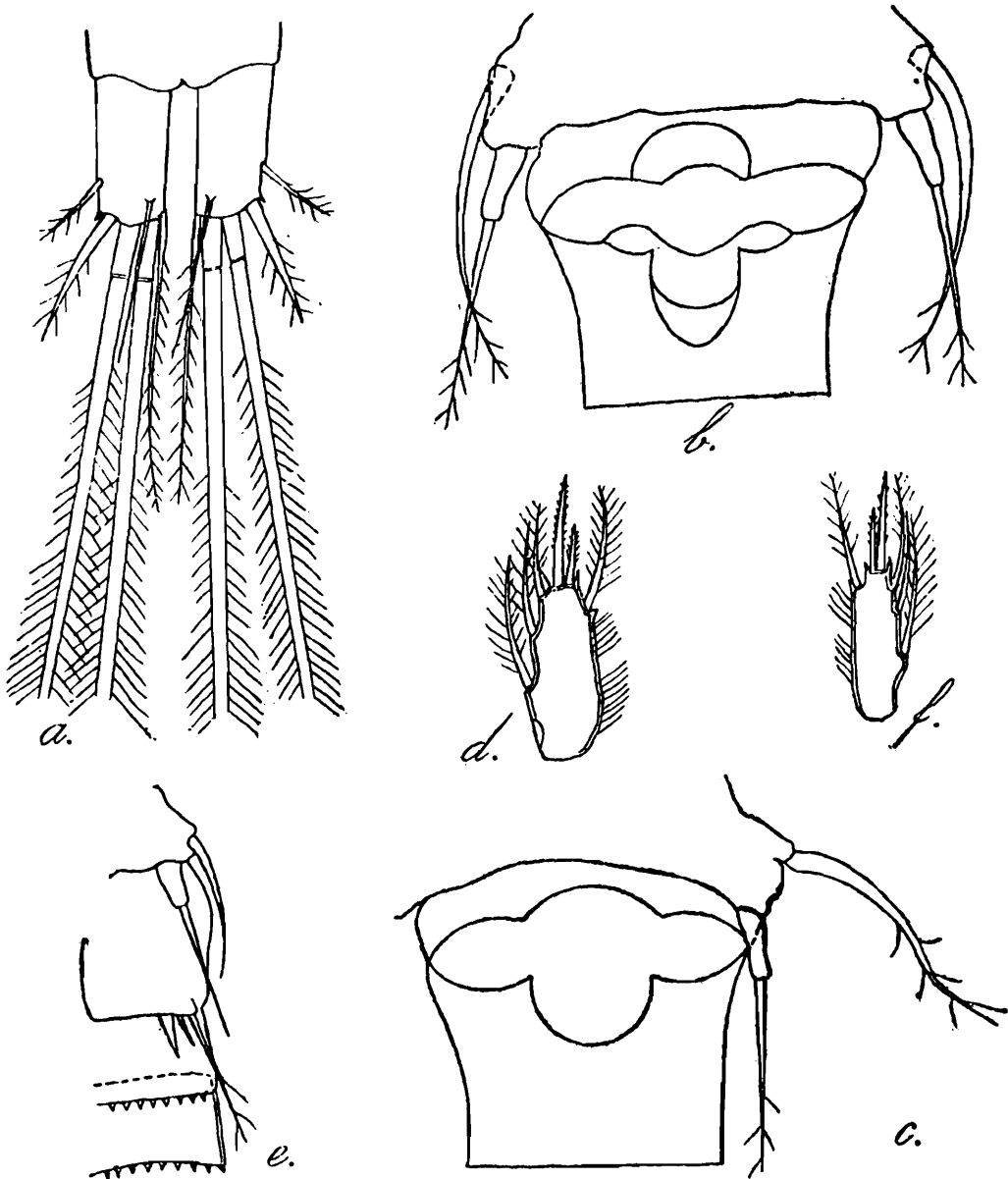


FIG. 6. *Cyclops (Microcyclops) davidi* var. *subtropicus* Lindberg.

a. ♀ Furca (Lac Véhar) ; b. ♀ Cinquième patte et segment génital (Kodaikanal) ; c. ♀ Cinquième patte et segment génital (Lac Véhar) ; d. ♀ Article terminal de l'enp. 4 (Lac Véhar) ; e. ♂ Cinquième et sixième pattes (Lac Véhar) ; f. ♂ Article terminal de l'enp. 4 (Lac Véhar).

patte et du réceptacle séminal, de sorte que j'ai cru devoir les distinguer comme une espèce nouvelle. Subséquemment j'ai pu collectionner,

tant dans des endroits divers de l'île de Salsette qu' à Kodaikanal dans les montagnes Palni du sud de l'Inde, un certain nombre d'animaux appartenant évidemment à cette même forme, mais montrant des variations dans la longueur des branches de la furca, de l'article de la cinquième patte et dans la structure du réceptacle séminal. Malheureusement je n'ai pas pu obtenir des spécimens originaux de *M. davidi*, le Dr. Chappuis n'en possédant plus, pour pouvoir les comparer, mais, en confrontant ces divers animaux indiens avec la description et les figures de Chappuis et de Kiefer, je me suis rendu compte que les différences entre le *M. subtropicus* et le *M. davidi* sont encore moins accusées que je ne l'avais cru en 1937, et il ne me semble plus justifié de maintenir le *M. subtropicus* comme une espèce distincte.

Les échantillons indiens diffèrent cependant d'une façon assez notable dans la structure de l'article terminal de l'enp. 4, l'épine apicale interne étant bien plus courte que l'article, tandis qu'elle atteint presque la longueur de l'article chez le *M. davidi*. Aussi, la différence de longueur qui existe entre les deux épines apicales est plus prononcée chez le *M. subtropicus*, ce rapport pouvant atteindre 1.76 : 1, tandis que Chappuis dit que ces deux épines sont presque de longueur égale dans le cas du *M. davidi*.

Par suite de ces particularités il me semble que le *M. subtropicus* doit être considéré comme une variété du *M. davidi*. Ses caractères principaux sont les suivants.

Espèce grande et robuste. Longueur de la femelle de 750 μ à 915 μ (sans les soies apicales). Première antenne à 12 articles. Branches de la furca parallèles, environ 2.5 fois aussi longues que larges (valeurs limites 2.12 : 1 et 2.8 : 1). Rapport moyen entre la longueur de la soie apicale interne et celle de la soie apicale externe de la furca de 1.68 : 1. Article terminal de l'enp. 4 de 2.18 à 2.6 fois aussi long que large (rapport moyen de 2.37 : 1). Epine apicale interne considérablement plus longue que l'épine apicale externe (rapport moyen de 1.47 : 1) ; elle est environ d'un tiers plus courte que l'article qui la porte (rapport moyen entre la longueur de l'article et de l'épine apicale interne 1.28 : 1).

Article de la cinquième patte très allongé de 3 à 5 fois aussi long que large, sans épine et, le plus souvent, sans éminence appréciable sur le rebord interne. Réceptacle séminal assez variable, répondant parfois à l'aspect de celui de *C. (M.) rubellus* Lilljeborg. Ovisacs grands, elliptiques ; atteignant ou dépassant l'extrémité de la furca ; ils contiennent chacun de 10 à 20 oeufs.

Mâle, long de 550 à 575 μ , à sixième patte rudimentaire formée d'une forte et courte épine interne, d'une petite soie médiane, légèrement plus longue que l'épine et d'une soie externe assez longue, qui peut dépasser le bord postérieur du deuxième segment abdominal.

Habitats.—(1) Ile de Salsette (Bombay) : Grottes Kanhéry, citerne ; mare, rivière et étang près du lac Povaï ; mare et petit étang près du lac Véhar ; rivière à environ 2 km. de Ghatkopar.

(2) Kodaikanal (montagnes Palni) : lac et bassin formé près d'une chute d'eau.

Clef de détermination des membres indiens connus du sous-genre Microcyclops Claus.

1. Première antenne à 9 articles—*C. (M.) karvei* Kiefer et Moorthy.
2. Première antenne à 10 articles :
Réceptacle séminal du type bicolor—*C. (M.) diminutus* Lindberg.
Réceptacle séminal du type vaticans—*C. (M.) moghulensis* Lindberg.
3. Première antenne à 11 articles :
Réceptacle séminal du type bicolor—*C. (M.) tricolor* Lindberg.
Réceptacle séminal du type varicans—*C. (M.) indo-lusitanus* Lindberg.
4. Première antenne à 12 articles :
Epine apicale interne de l'enp. 4 élargie dans sa partie proximale—*C. (M.) varicans* Sars.
Epine apicale interne de l'enp. 4 sans élargissement dans sa partie proximale—5.
5. Branches de la furca de 3 à 4.5 fois aussi longues que larges—*C. (M.) varicans* var. *subaequalis* (Kiefer).
6. Branches de la furca d'environ 2.5 fois aussi longues que larges—*C. (M.) davidi* var. *subtropicus* (Lindberg).

RÉSUMÉ.

(1) Huit formes distinctes sont maintenant connues de l'Inde du sous-genre *Microcyclops* Claus, du genre *Cyclops* Müller.

Deux d'entre elles appartiennent au groupe *bicolor* et 6 au groupe *varicans*.

(2) Les caractères principaux de ces formes sont récapitulés et une clef d'identification donnée.

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TABLEAU I.

M. diminutus.

Localité.	Longueur μ.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Danoli. Rivière (Etat de Savantvadi)	551	(30+13) : 16=2.68 : 1	66 : 31=2.13 : 1	33 : 13=2.54 : 1	15 : 7=2.14 : 1	33 : 15=2.2 : 1
Lac Povaī. Rivière (Ile de Salsette)	546	(33+10) : 15.5=2.77 : 1	76 : 33=2.30 : 1	35 : 13=2.69 : 1	18 : 8=2.25 : 1	35 : 18=1.94 : 1
Bassin. Citerne	551	(39+14) : 17=3.12 : 1	71 : 33=2.15 : 1	41 : 18=2.28 : 1	29 : 10=2.9 : 1	41 : 29=1.41 : 1

TABLEAU II.

M. tricolor.

Localité.	Longueur μ.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Nadiad	570	(35+15) : 16=3.12 : 1	76 : 36=2.11 : 1	40 : 15=2.66 : 1	30 : 8=3.75 : 1	40 : 30=1.33 : 1
Chédi. Rivière	560	(37+11) : 16=3 : 1	75 : 33=2.27 : 1	38 : X=X : 1	X : 8=X : 1	38 : X=X : 1
	575	(40+13) : 16=3.31 : 1	73 : 41=1.78 : 1	41 : 17=2.41 : 1	31 : 8=3.87 : 1	41 : 31=1.32 : 1

Djogechvari	622	$(38+13) : 16=3.19 : 1$	$83 : 36=2.3 : 1$	$41 : 16=2.56 : 1$	$31 : 11=2.82 : 1$	$41 : 31=1.32 : 1$
Etang	617	$(38+15) : 16=3.31 : 1$	$86 : 40=2.15 : 1$	....	....	....
Lac Povai	798	$(48+18) : 18=3.67 : 1$	$90 : 38=2.37 : 1$	$43 : 20=2.15 : 1$	$35 : 10=3.5 : 1$	$43 : 35=1.23 : 1$
Rivière	617	$(35+15) : 18=2.78 : 1$	$76 : 40=1.9 : 1$	$41 : 16=2.56 : 1$	$33 : 11=3 : 1$	$41 : 33=1.24 : 1$
Elephanta. Etangs	632	$(41+15) : 17=3.29 : 1$	$83 : 33=2.51 : 1$	$41 : 16=2.56 : 1$	$31 : 10=3.1 : 1$	$41 : 31=1.32 : 1$
	617	$(35+15) : 16=3.12 : 1$	$71 : 35=2.03 : 1$	$41 : 16=2.56 : 1$	$31 : 13=2.38 : 1$	$41 : 31=1.32 : 1$
	570	$(34+11) : 14=3.21 : 1$	$75 : 33=2.27 : 1$	$38 : 13=2.92 : 1$	$28 : 10=2.8 : 1$	$38 : 28=1.36 : 1$
	617	$(40+10) : 16=3.12 : 1$	$78 : 35=2.23 : 1$	$41 : 15=2.73 : 1$	$28 : 8=3.5 : 1$	$41 : 28=1.46 : 1$
	617	$(35+15) : 16=3.12 : 1$	$75 : 36=2.08 : 1$	$40 : 15=2.66 : 1$	....	....
Ellora. Citerne près du réservoir	646	$(38+13) : 16=3.19 : 1$	$78 : 33=2.36 : 1$	$41 : 16=2.56 : 1$	$30 : 8=3.75 : 1$	$41 : 30=1.37 : 1$
	646	$(40+13) : 16=3.31 : 1$	$83 : 33=2.51 : 1$	$41 : 16=2.56 : 1$	$30 : 8=3.75 : 1$	$41 : 30=1.37 : 1$
Ellora, grottes. Ruis- seau	646	$(37+16) : 18=2.94 : 1$	$83 : 45=1.84 : 1$	$48 : 16=3 : 1$	$35 : 12=2.92 : 1$	$48 : 35=1.37 : 1$
	646	$(41+15) : 16=3.5 : 1$	$85 : 33=2.57 : 1$	$43 : 17=2.53 : 1$	$33 : 10=3.3 : 1$	$43 : 33=1.3 : 1$

TABLEAU II (Suite).

Localité.	Longueur μ.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Ellora, village. Ré- servoir	617	(36+15) : 16=3·19 : 1	80 : 33=2·42 : 1	45 : 16=2·81 : 1	29 : 8=3·62 : 1	45 : 29=1·55 : 1
	617	(38+15) : 16=3·31 : 1	86 : 36=2·39 : 1	40 : 16=2·5 : 1	31 : 10=3·1 : 1	40 : 31=1·29 : 1
	627	(38+15) : 16=3·31 : 1	80 : 33=2·42 : 1	43 : 16=2·68 : 1	33 : 8=4·12 : 1	43 : 33=1·3 : 1
	646	(44+16) : 16=3·75 : 1	86 : 35=2·46 : 1	41 : 16=2·56 : 1	33 : 9=3·66 : 1	41 : 33=1·24 : 1
	617	(36+15) : 16=3·19 : 1	83 : 33=2·51 : 1	40 : 16=2·5 : 1	30 : 9=3·33 : 1	40 : 30=1·33 : 1
	608	(35+16) : 16=3·19 : 1	X : 33=X : 1	..	....	
Kouldabad. Puits	627	(43+13) : 18=3·11 : 1	86 : 45=1·91 : 1	43 : 16=2·68 : 1	30 : 8=3·75 : 1	43 : 30=1·43 : 1
	665	(38+15) : 18=2·94 : 1	86 : 45=1·91 : 1	43 : 16=2·68 : 1	33 : 10=3·3 : 1	43 : 33=1·3 : 1
Kouldabad. Etang	617	(41+15) : 17=3·29 : 1	81 : 40=2·02 : 1	40 : 16=2·5 : 1	33 : 9=3·66 : 1	40 : 33=1·21 : 1
	646	(45+13) : 17=3·41 : 1	83 : 40=2·07 : 1	41 : 16=2·56 : 1	28 : 10=2·8 : 1	41 : 28=1·46 : 1
Latour. Etang	684	(43+15) : 20=2·9 : 1	95 : 45=2·11 : 1	48 : 18=2·67 : 1	33 : 10=3·3 : 1	48 : 33=1·45 : 1
Haïderabad. Mare	627	(36+15) : 17=3 : 1	85 : 36=2·36 : 1	41 : 16=2·56 : 1	33 : 10=3·3 : 1	41 : 33=1·24 : 1

Haïderabad Réservoir	617	$(35+15) : 16=3.12 : 1$	$76 : 33=2.3 : 1$	$40 : 16=2.5 : 1$	$23 : 8=2.87 : 1$	$40 : 23=1.74 : 1$
	646	$(38+15) : 17=3.12 : 1$	$83 : 38=2.18 : 1$	$45 : 16=2.81 : 1$	$33 : 10=3.3 : 1$	$45 : 33=1.36 : 1$
Gharipouri. Rivière	589	$(35+13) : 17=2.82 : 1$	$78 : 33=2.36 : 1$	$43 : 16=2.68 : 1$	$29 : 10=2.9 : 1$	$43 : 29=1.48 : 1$
	589	$(39+11) : 16=3.12 : 1$	$71 : 33=2.15 : 1$	....	....	....
	598	$(35+15) : 16=3.12 : 1$	$83 : 33=2.51 : 1$	$40 : 15.5=2.58 : 1$	$28 : 10=2.8 : 1$	$40 : 28=1.43 : 1$
Pandharpour. Mare	665	$(35+13) : 16=3 : 1$	$65 : 36=1.8 : 1$	$41 : 16=2.56 : 1$	$30 : 8=3.75 : 1$	$41 : 30=1.37 : 1$
Pandharpour. Réservoir	617	$(38+13) : 16=3.19 : 1$	$73 : 41=1.78 : 1$	$41 : 15=2.73 : 1$	$26 : 8=3.25 : 1$	$41 : 26=1.58 : 1$
Pandharpour. Rivière Bhima	579	$(35+15) : 17=2.94 : 1$	$76 : 33=2.3 : 1$	$36 : 16=2.25 : 1$	$33 : 10=3.3 : 1$	$36 : 33=1.09 : 1$
	617	$(40+13) : 17=3.12 : 1$	$80 : 38=2.1 : 1$	$41 : 16=2.56 : 1$	$28 : 8=3.5 : 1$	$41 : 28=1.46 : 1$
	636	$(41+15) : 18=3.11 : 1$	$83 : 36=2.3 : 1$	$41 : 16=2.56 : 1$	$33 : 9=3.66 : 1$	$41 : 33=1.24 : 1$
	..	$(38+15) : 16=3.31 : 1$	$76 : 33=2.3 : 1$	$38 : 16=2.37 : 1$	$28 : 8=3.5 : 1$	$38 : 28=1.36 : 1$
Pandharpour. Puits	703	$(41+15) : 20=2.8 : 1$	$86 : 41=2.09 : 1$	$41 : 17=2.41 : 1$	$31 : 8=3.87 : 1$	$41 : 31=1.32 : 1$
	660	$(41+15) : 18=3.11 : 1$	$86 : 45=1.91 : 1$	$41 : 17=2.41 : 1$	$32 : 10=3.2 : 1$	$41 : 32=1.28 : 1$

TABLEAU II (Fin).

Localité.	Longueur μ .	Furca. Longueur : largeur.	Furca. Soie apic. int. soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Arkonam. Etang	684	$(38+13) : 16=3.19 : 1$	$71 : 33=2.15 : 1$	$40 : 16=2.5 : 1$	$26 : 9=2.89 : 1$	$40 : 26=1.54 : 1$
	712	$(37+13) : 16=3.12 : 1$	$68 : 33=2.06 : 1$	$41 : 15=2.73 : 1$	$30 : 8=3.75 : 1$	$41 : 30=1.37 : 1$
	665	$(40+13) : 16=3.31 : 1$	$83 : 35=2.37 : 1$	$40 : 16=2.5 : 1$	$X : 9=X : 1$	$40 : X=X : 1$
	722	$(41+15) : 16=3.5 : 1$	$75 : 36=2.08 : 1$	$40 : 17=2.35 : 1$	$28 : 8=3.5 : 1$	$40 : 28=1.43 : 1$
Villénour. Etang	560	$(37+13) : 16=3.12 : 1$	$75 : 33=2.27 : 1$	$40 : 15=2.56 : 1$	$31 : 8=3.87 : 1$	$40 : 31=1.29 : 1$
Villénour. Mare	589	$(35+15) : 16=3.12 : 1$	$70 : 33=2.12 : 1$	$41 : 16=2.56 : 1$	$31 : 9=3.44 : 1$	$41 : 31=1.32 : 1$
Pondichéry. Etang	598	$(37+13) : 16=3.12 : 1$	$70 : 40=1.75 : 1$	....	....	..
	565	$(35+15) : 16=3.12 : 1$	$75 : 38=1.97 : 1$	$40 : 15=2.66 : 1$	$31 : 8=3.87 : 1$	$40 : 31=1.29 : 1$
Ootacamund. Lac	750	$(49+16) : 21=3.09 : 1$	$85 : 38=2.24 : 1$	$41 : 19=2.16 : 1$	$28 : 11=2.54 : 1$	$41 : 28=1.46 : 1$
	665	$(41+15) : 18=3.11 : 1$	$83 : 38=2.18 : 1$	$45 : 17=2.65 : 1$	$33 : 10=3.3 : 1$	$45 : 33=1.36 : 1$
Moyennes	632.4	$52.76 : 16.68=3.16 : 1$	$79.44 : 36.62=2.17 : 1$	$41.25 : 16.09=2.56 : 1$	$30.54 : 9.19=3.32 : 1$	$41.25 : 30.54=1.35 : 1$

TABLEAU III.

M. varicans.

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Nagpour. Etang	(50+23) : 20=3.65 : 1	72 : 50=1.44 : 1	66 : 26=2.54 : 1	50 : 30=1.67 : 1	66 : 50=1.32 : 1
Nadiad	(40+20) : 16=3.75 : 1	73 : 58=1.26 : 1	75 : 28=2.68 : 1	50 : 28=1.78 : 1	75 : 50=1.5 : 1
Chédi	(52+20) : 18=4 : 1	70 : 53=1.32 : 1	76 : 26=2.92 : 1	48 : 28=1.71 : 1	76 : 48=1.58 : 1
Rivière	(48+18) : 17=3.88 : 1	70 : 60=1.17 : 1	73 : 26=2.8 : 1	46 : 27=1.7 : 1	73 : 46=1.59 : 1
	(47+18) : 18=3.61 : 1	58 : 46=1.26 : 1	76 : 28=2.71 : 1	43 : 26=1.65 : 1	76 : 43=1.77 : 1
Moyenne	(46.75+19) : 17.25=3.81 : 1	67.75 : 54.25=1.25 : 1	75 : 27=2.78 : 1	46.75 : 27.25=1.72 : 1	75 : 46.75=1.6 : 1
Ellora. Citerne	(48+18) : 18=3.67 : 1	75 : 50=1.5 : 1	76 : 17=4.47 : 1	48 : 30=1.6 : 1	76 : 48=1.58 : 1
Ellora	63 : 17=3.7 : 1	....	....	....	....
Réservoir	65 : 20=3.25 : 1	....	76 : 30=2.53 : 1	46 : 30=1.53 : 1	76 : 46=1.65 : 1
	(46+20) : 20=3.3 : 1	86 : 50=1.72 : 1	80 : 29=2.76 : 1	50 : 30=1.67 : 1	80 : 50=1.6 : 1

TABLEAU III (Suite).

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Aurangabad	$(50+20) : 18=3.89 : 1$	$63 : 53=1.19 : 1$	$71 : 25=2.84 : 1$	$45 : 25=1.8 : 1$	$71 : 45=1.58 : 1$
Mare de rivière	$(50+20) : 18=3.89 : 1$	....	$70 : 23=3.04 : 1$	$41 : 25=1.64 : 1$	$70 : 41=1.7 : 1$
Haïdérabad	$(57+23) : 20=4 : 1$	$86 : 60=1.43 : 1$	$81 : 28=2.89 : 1$	$58 : 33=1.76 : 1$	$81 : 58=1.39 : 1$
Puits	$(60+26) : 20=4.3 : 1$	$76 : 58=1.31 : 1$	$85 : 31=2.74 : 1$	$53 : 30=1.77 : 1$	$85 : 53=1.6 : 1$
Haïdérabad	$(55+21) : 18=4.22 : 1$	$70 : 50=1.4 : 1$	$77 : 26=2.96 : 1$	$50 : 28=1.78 : 1$	$77 : 50=1.54 : 1$
Réservoir Mir Alam	$(50+20) : 18=3.89 : 1$	$58 : 50=1.16 : 1$	$71 : 26=2.73 : 1$	$50 : 26=1.92 : 1$	$71 : 50=1.42 : 1$
	$(50+21) : 18=3.94 : 1$	$66 : 50=1.32 : 1$	$80 : 25=3.2 : 1$	$48 : 30=1.6 : 1$	$80 : 48=1.67 : 1$
	$(46+20) : 21=3.14 : 1$	$75 : 50=1.5 : 1$	$81 : 26=3.11 : 1$	$50 : 28=1.78 : 1$	$81 : 50=1.62 : 1$
Moyenne	$(50.25+20.5) : 18.75=3.77:1$	$67.25 : 50=1.34 : 1$	$77.25 : 25.75=3 : 1$	$49.5 : 28=1.77 : 1$	$77.25 : 49.5=1.56 : 1$

Haïdérabad	(48+22) : 18=3.89 : 1	63 : 46=1.37 : 1	....	....	....
Lac Himayat	(47+18) : 17=3.82 : 1	56 : 43=1.3 : 1	66 : 26=2.54 : 1	41 : 25=1.64 : 1	66 : 41=1.61 : 1
	(53+20) : 18=4.05 : 1	56 : 41=1.37 : 1	76 : 26=2.92 : 1	48 : 27=1.78 : 1	76 : 48=1.58 : 1
	(48+20) : 18=3.79 : 1	67 : 40=1.67 : 1	66 : 23=2.87 : 1	48 : 33=1.45 : 1	66 : 48=1.37 : 1
	(49+18) : 18=3.72 : 1	58 : 42=1.38 : 1	68 : 22=3.09 : 1	42 : 25=1.68 : 1	68 : 42=1.62 : 1
	(50+18) : 18=3.78 : 1	57 : 48=1.19 : 1	70 : 23=3.04 : 1	42 : 23=1.83 : 1	70 : 42=1.67 : 1
	68 : 18=3.78 : 1	....	....	....	....
	73 : 20=3.65 : 1	....	....	....	....
	(49+21) : 18=3.89 : 1	58 : 48=1.2 : 1	....	....	....
Moyenne	69.11 : 18.11=3.82 : 1	59.28 : 44=1.35 : 1	69.2 : 24=2.88 : 1	44.2 : 26.6=1.66 : 1	69.2 : 44.2=1.56 : 1
Elephanta	(50+23) : 18=4.05 : 1	66 : 50=1.32 : 1	75 : 27=2.78 : 1	46 : 28=1.64 : 1	75 : 46=1.63 : 1
Etangs	(46+20) : 17=3.88 : 1	66 : 50=1.32 : 1	70 : 26=2.69 : 1	41 : 26=1.58 : 1	70 : 41=1.7 : 1
(4 localités différentes)	(48+20) : 18=3.78 : 1	73 : 56=1.3 : 1	73 : 26=2.8 : 1	41 : 26=1.58 : 1	73 : 41=1.78 : 1
	(47+18) : 16=4.06 : 1	65 : 48=1.35 : 1	68 : 23=2.95 : 1	41 : 25=1.64 : 1	68 : 41=1.66 : 1
	(46+20) : 18=3.67 : 1	63 : 48=1.31 : 1	66 : 23=2.87 : 1	43 : 25=1.72 : 1	66 : 43=1.53 : 1
Moyenne	(47.4+20.2) : 17.4=3.88 : 1	66.6 : 50.4=1.32 : 1	70.4 : 25=2.82 : 1	42.4 : 26=1.63 : 1	70.4 : 42.4=1.66 : 1

TABLEAU III (Suite).

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Elephanta	(41+25) : 18=3·67 : 1	70 : 50=1·37 : 1	75 : 25=3 : 1	41 : 25=1·64 : 1	75 : 41=1·83 : 1
Citernes	58 : 16=3·62 : 1	....	70 : 24=2·92 : 1	38 : 25=1·52 : 1	70 : 38=1·84 : 1
Lac Pováí. Rivière près du lac	(45+23) : 20=3·4 : 1 (48+25) : 18=4·05 : 1 (50+21) : 19=3·74 : 1 (48+23) : 20=3·55 : 1 (47+23) : 18=3·89 : 1 (46+20) : 18=3·67 : 1 (48+18) : 17=3·88 : 1 (50+20) : 20=3·5 : 1	66 : 50=1·32 : 1 73 : 58=1·26 : 1 75 : 50=1·5 : 1 75 : 50=1·5 : 1 66 : 50=1·32 : 1 58 : 50=1·16 : 1 70 : 50=1·4 : 1	70 : 26=2·69 : 1 80 : 26=3·07 : 1 75 : 28=2·68 : 1 75 : 28=2·68 : 1 73 : 28=2·6 : 1 75 : 25=3 : 1 70 : 25=2·8 : 1 70 : 28=2·5 : 1	48 : 28=1·71 : 1 50 : 33=1·52 : 1 51 : 31=1·65 : 1 51 : 28=1·82 : 1 50 : 33=1·52 : 1 53 : 31=1·71 : 1 43 : 26=1·65 : 1 48 : 29=1·65 : 1	70 : 48=1·46 : 1 80 : 50=1·6 : 1 75 : 51=1·47 : 1 75 : 51=1·47 : 1 73 : 50=1·46 : 1 75 : 53=1·42 : 1 70 : 43=1·63 : 1 70 : 48=1·64 : 1
Moyenne	(47·75+21·62) : 18·75=3·69 : 1	69 : 51·14=1·35 : 1	73·5 : 26·75=2·75 : 1	49·25 : 29·87=1·65 : 1	73·5 : 49·25=1·49 : 1
Lac Pováí. Etang près du lac	(53+20) : 20=3·65 : 1 (50+20) : 18=3·89 : 1	75 : 51=1·47 : 1 61 : 51=1·19 : 1	70 : 26=2·69 : 1 78 : 26=3·1	48 : 31=1·55 : 1 48 : 25=1·92 : 1	70 : 48=1·46 : 1 78 : 48=1·62 : 1

Ghatkopar	$(52+21) : 20=3.65 : 1$	$66 : 50=1.32 : 1$	$75 : 26=2.88 : 1$	$46 : 30=1.53 : 1$	$75 : 46=1.63 : 1$
Rivière	$(50+20) : 17=4.12 : 1$	$60 : 50=1.2 : 1$	$70 : 26=2.69 : 1$	$50 : 28=1.78 : 1$	$70 : 50=1.4 : 1$
Lonavla. Mare de rivière	$(45+21) : 17=3.88 : 1$	....	$68 : 26=2.62 : 1$	$41 : 25=1.64 : 1$	$68 : 41=1.66 : 1$
Karli	$(59+21) : 18=4.44 : 1$	$66 : 56=1.18 : 1$	$75 : 27=2.78 : 1$	$48 : X=X : 1$	$75 : 48=1.56 : 1$
Étang	$(55+23) : 18=4.33 : 1$	$70 : 51=1.37 : 1$	$75 : 26=2.88 : 1$	$43 : 26=1.65 : 1$	$75 : 43=1.74 : 1$
	$(52+23) : 17=4.41 : 1$	$66 : 50=1.32 : 1$	$70 : 27=2.59 : 1$	$45 : 24=1.87 : 1$	$70 : 45=1.56 : 1$
Malavli. Etang	$(55+23) : 18=4.33 : 1$	$70 : 55=1.27 : 1$	$75 : 28=2.68 : 1$	$48 : 30=1.6 : 1$	$75 : 48=1.56 : 1$
	$(59+21) : 20=4 : 1$	$70 : 50=1.4 : 1$	$83 : 30=2.77 : 1$	$48 : 30=1.6 : 1$	$83 : 48=1.73 : 1$
Gharipouri. Rivière	$(47+18) : 20=3.25 : 1$	$66 : 50=1.32 : 1$	$70 : 25=2.8 : 1$	$45 : 23=1.96 : 1$	$70 : 45=1.56 : 1$
	$(43+20) : 20=3.15 : 1$	....	$72 : 23=3.13 : 1$	$41 : 23=1.78 : 1$	$72 : 41=1.76 : 1$
	$(46+20) : 20=3.3 : 1$	....	$75 : 27=2.78 : 1$	$43 : 25=1.72 : 1$	$75 : 43=1.74 : 1$
	....	....	$68 : 23=2.96 : 1$	$40 : 22=1.82 : 1$	$68 : 40=1.7 : 1$
	$(39+17) : 18=3.11 : 1$	$66 : 42=1.57 : 1$	$68 : 24=2.83 : 1$	$40 : 20=2 : 1$	$68 : 40=1.7 : 1$
	$(38+20) : 18=3.22 : 1$	$58 : 50=1.16 : 1$	$65 : 23=2.83 : 1$	$45 : 25=1.8 : 1$	$65 : 45=1.44 : 1$
	$(45+20) : 18=3.61 : 1$	$68 : 43=1.35 : 1$	$61 : 24=2.54 : 1$	$38 : 23=1.65 : 1$	$61 : 38=1.6 : 1$
	$(45+21) : 17=3.88 : 1$	$63 : 45=1.62 : 1$	$68 : 23=2.95 : 1$	$45 : 25=1.8 : 1$	$68 : 45=1.51 : 1$
	$(36+20) : 20=2.8 : 1$	$70 : 41=1.7 : 1$	$73 : 25=2.92 : 1$	$41 : 25=1.64 : 1$	$73 : 41=1.78 : 1$
	$(38+18) : 18=3.11 : 1$	$66 : 41=1.61 : 1$	$68 : 24=2.83 : 1$	$48 : 25=1.92 : 1$	$68 : 48=1.42 : 1$
	$(42+16) : 19=3.05 : 1$	$66 : 50=1.32 : 1$	$70 : 25=2.8 : 1$	$40 : 23=1.74 : 1$	$70 : 40=1.75 : 1$

TABLEAU III (Suite).

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Moyenne	$(41.9 + 19) : 18.8 = 3.24 : 1$	$64.12 : 45.25 = 1.42 : 1$	$68.91 : 24.18 = 2.85 : 1$	$42.36 : 23.54 = 1.79 : 1$	$68.91 : 42.36 = 1.63 : 1$
Gharipouri. Mare	$(48 + 18) : 18 = 3.67 : 1$ $70 : 18 = 3.89 : 1$ $(48 + 18) : 18 = 3.67 : 1$	$66 : 50 = 1.32 : 1$ $66 : 51 = 1.29 : 1$	$70 : 26 = 2.69 : 1$ $73 : 27 = 2.7 : 1$ $68 : 25 = 2.72 : 1$	$41 : 23 = 1.78 : 1$ $41 : 25 = 1.64 : 1$ $43 : 25 = 1.72 : 1$	$70 : 41 = 1.7 : 1$ $73 : 41 = 1.78 : 1$ $68 : 43 = 1.58 : 1$
Mahisgaon. Rivière Sina	$(46 + 20) : 20 = 3.3 : 1$ $(50 + 25) : 21 = 3.57 : 1$	$66 : 50 = 1.32 : 1$ $80 : 55 = 1.45 : 1$	$73 : 26 = 2.8 : 1$ $71 : 30 = 2.37 : 1$	$45 : 25 = 1.8 : 1$ $43 : 25 = 1.72 : 1$	$73 : 45 = 1.62 : 1$ $71 : 43 = 1.65 : 1$
Pandhar ₁ our. Rivière Takli	$(50 + 20) : 20 = 3.5 : 1$ $(55 + 20) : 20 = 3.75 : 1$ $(48 + 18) : 18 = 3.67 : 1$ $(55 + 20) : 20 = 3.75 : 1$ $(60 + 20) : 20 = 4 : 1$	$75 : 53 = 1.42 : 1$ $66 : 50 = 1.32 : 1$ $66 : 46 = 1.43 : 1$ $66 : 56 = 1.18 : 1$ $68 : 56 = 1.21 : 1$	$75 : 27 = 2.78 : 1$ $70 : 25 = 2.8 : 1$ $68 : 24 = 2.83 : 1$ $76 : 28 = 2.71 : 1$ $75 : 28 = 2.68 : 1$	$43 : 25 = 1.72 : 1$ $41 : 25 = 1.64 : 1$ $36 : 24 = 1.5 : 1$ $50 : 32 = 1.56 : 1$ $43 : 25 = 1.72 : 1$	$75 : 43 = 1.74 : 1$ $70 : 41 = 1.7 : 1$ $68 : 36 = 1.89 : 1$ $76 : 50 = 1.4 : 1$ $75 : 43 = 1.74 : 1$

Moyenne	$(53.6 + 19.6) : 19.6 = 3.73 : 1$	$68.2 : 52.2 = 1.3 : 1$	$72.8 : 26.4 = 2.76 : 1$	$42.6 : 26.2 = 1.63 : 1$	$72.8 : 42.6 = 1.7 : 1$
Pandharpour. Réservoir	$(55 + 20) : 20 = 3.75 : 1$ $(50 + 18) : 18 = 3.78 : 1$ $(45 + 18) : 18 = 3.5 : 1$ $(46 + 20) : 18 = 3.67 : 1$ $(55 + 25) : 23 = 3.47 : 1$ $(43 + 20) : 20 = 3.15 : 1$ $(55 + 25) : 21 = 3.8 : 1$ $(57 + 23) : 21 = 3.8 : 1$ $(55 + 20) : 21 = 3.57 : 1$ $(51 + 20) : 18 = 3.94 : 1$ $(46 + 20) : 18 = 3.67 : 1$ $(48 + 18) : 18 = 3.67 : 1$ $(57 + 16) : 18 = 4.05 : 1$	$58 : 50 = 1.16 : 1$ $66 : 50 = 1.32 : 1$ $66 : 50 = 1.32 : 1$ $63 : 43 = 1.46 : 1$ $90 : 51 = 1.76 : 1$ $83 : 50 = 1.66 : 1$ $83 : 53 = 1.57 : 1$ $78 : 53 = 1.47 : 1$ $58 : 50 = 1.16 : 1$ $68 : 50 = 1.36 : 1$ $66 : 50 = 1.32 : 1$ $65 : 43 = 1.51 : 1$ $53 : 43 = 1.23 : 1$	$70 : 26 = 2.69 : 1$ $70 : 24 = 2.92 : 1$ $65 : 24 = 2.7 : 1$ $70 : 25 = 2.8 : 1$ $86 : 35 = 2.46 : 1$ $78 : 26 = 3 : 1$ $81 : 31 = 2.61 : 1$ $80 : 28 = 2.85 : 1$ $75 : 29 = 2.58 : 1$ $71 : 25 = 2.84 : 1$ $75 : 25 = 3 : 1$ $73 : 26 = 2.8 : 1$ $71 : 25 = 2.84 : 1$	$41 : 25 = 1.64 : 1$ $48 : 28 = 1.71 : 1$ $45 : 26 = 1.73 : 1$ $38 : 23 = 1.65 : 1$ $45 : 28 = 1.6 : 1$ $50 : 28 = 1.78 : 1$ $41 : 26 = 1.58 : 1$ $48 : 25 = 1.92 : 1$ $46 : 26 = 1.73 : 1$ $41 : 25 = 1.64 : 1$ $45 : 26 = 1.73 : 1$ $43 : 26 = 1.65 : 1$ $45 : 26 = 1.73 : 1$	$70 : 41 = 1.7 : 1$ $70 : 48 = 1.46 : 1$ $65 : 45 = 1.44 : 1$ $70 : 38 = 1.84 : 1$ $86 : 45 = 1.91 : 1$ $78 : 50 = 1.56 : 1$ $81 : 41 = 1.97 : 1$ $80 : 48 = 1.67 : 1$ $75 : 46 = 1.63 : 1$ $71 : 41 = 1.73 : 1$ $75 : 45 = 1.67 : 1$ $73 : 43 = 1.69 : 1$ $71 : 45 = 1.58 : 1$
Moyenne	$(51 + 20.23) : 19.39 = 3.67 : 1$	$69 : 48.92 = 1.41 : 1$	$74.23 : 26.84 = 2.76 : 1$	$44.3 : 26 = 1.7 : 1$	$74.23 : 44.3 = 1.69 : 1$
Pandharpour. Puits	$(57 + 23) : 23 = 3.48 : 1$	$66 : 53 = 1.25 : 1$	$70 : 30 = 2.33 : 1$	$44 : 28 = 1.57 : 1$	$70 : 44 = 1.59 : 1$

TABLEAU III (Suite).

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Pandharpour. Rivière Bhima	(45+20) : 18=3·61 : 1	76 : 46=1·65 : 1	75 : X=X : 1	46 : 26=1·73 : 1	75 : 46=1·63 : 1
	73 : 19=3·84 : 1	....	....	46 : 25=1·84 : 1	....
	(43+20) : 20=3·15 : 1	75 : 51=1·47 : 1	73 : 25=2·92 : 1	48 : 26=1·85 : 1	73 : 48=1·52 : 1
	(49+21) : 20=3·5 : 1	71 : 65=1·09 : 1	71 : 26=2·73 : 1	45 : 25=1·8 : 1	71 : 45=1·58 : 1
Pandharpour. Mare	(59+23) : 20=4·1 : 1	60 : 50=1·2 : 1	76 : 28=2·71 : 1	45 : 26=1·73 : 1	76 : 45=1·69 : 1
Danoli. Rivières (Plusieurs habitats différents)	(46+20) : 18=3·67 : 1	60 : 45=1·33 : 1	65 : 26=2·5 : 1	38 : 23=1·65 : 1	65 : 38=1·71 : 1
	(50+20) : 20=3·5 : 1	66 : 50=1·32 : 1	70 : 26=2·69 : 1	41 : 25=1·64 : 1	70 : 41=1·7 : 1
	(45+18) : 18=3·5 : 1	60 : 43=1·39 : 1	66 : 25=2·64 : 1	38 : 21=1·81 : 1	66 : 38=1·74 : 1
	(42+18) : 18=3·33 : 1	58 : 40=1·45 : 1	63 : 21=3 : 1	36 : 21=1·71 : 1	63 : 36=1·75 : 1
	(50+20) : 18=3·89 : 1	63 : 50=1·26 : 1	....	....	....
	(50+23) : 20=3·65 : 1	58 : 46=1·26 : 1	73 : 26=2·8 : 1	41 : 21=1·95 : 1	73 : 41=1·78 : 1
	(43+23) : 18=3·67 : 1	61 : 45=1·36 : 1	70 : 24=2·92 : 1	41 : 25=1·64 : 1	70 : 41=1·7 : 1
	(48+18) : 18=3·67 : 1	55 : 42=1·31 : 1	65 : 22=2·95 : 1	39 : 20=1·95 : 1	65 : 39=1·67 : 1
	(51+20) : 18=3·94 : 1	66 : 50=1·32 : 1	70 : 23=3·04 : 1	40 : 23=1·74 : 1	70 : 40=1·75 : 1

Moyenne	(48·11+20 : 18·44=3·69 : 1	60·78 : 45·66=1·33 : 1	67·75 : 24·12=2·89 : 1	39·25 : 22·37=1·75 : 1	67·75 : 39·25=1·73 : 1
Vengurla. Mare	(54+21) : 18=4·17 : 1 (55+20) : 18=4·17 : 1	58 : 50=1·16 : 1 75 : 50=1·5 : 1	75 : 26=2·88 : 1 75 : 26=2·88 : 1	40 : 25=1·6 : 1 41 : 26=1·58 : 1	75 : 40=1·87 : 1 75 : 41=1·83 : 1
Cansaulim. Etang	(44+21) : 18=3·61 : 1 (48+18) : 17=3·88 : 1 (41+20) : 18=3·39 : 1	70 : 43=1·63 : 1 66 : 40=1·65 : 1 66 : 46=1·43 : 1	70 : 26=2·69 : 1 66 : 25=2·64 : 1 65 : 26=2·5 : 1	41 : 25=1·64 : 1 44 : 24=1·83 : 1 42 : 25=1·68 : 1	70 : 41=1·7 : 1 66 : 44=1·5 : 1 65 : 42=1·55 : 1
Cansaulin. Fosse	(42+16) : 18=3·22 : 1 (40+18) : 19=3·05 : 1 (46+20) : 19=3·47 : 1 (45+20) : 19=3·42 : 1 (44+19) : 18=3·5 : 1	63 : 36=1·75 : 1 70 : 48=1·46 : 1 71 : 50=1·42 : 1 68 : 46=1·48 : 1 68 : 41=1·66 : 1	66 : 25=2·64 : 1 66 : 25=2·64 : 1 70 : 26=2·69 : 1 70 : 26=2·69 : 1 66 : 26=2·54 : 1	41 : 25=1·64 : 1 41 : 25=1·64 : 1 46 : 28=1·64 : 1 48 : 25=1·92 : 1 43 : 26=1·65 : 1	66 : 41=1·61 : 1 66 : 41=1·61 : 1 70 : 46=1·52 : 1 70 : 48=1·46 : 1 66 : 43=1·53 : 1
Moyenne	(43·4+18·6) : 18·6=3·33 : 1	68 : 44·2=1·54 : 1	67·6 : 25·6=2·64 : 1	43·8 : 25·8=1·69 : 1	67·6 : 43·8=1·54 : 1
Pondichéry. Petite rivière	(45+18) : 18=3·5 : 1 (45+18) : 20=3·15 : 1	75 : 45=1·67 : 1 75 : 50=1·5 : 1	66 : 26=2·54 : 1 76 : 25=3·04 : 1	45 : 28=1·6 : 1 45 : 26=1·73 : 1	66 : 45=1·47 : 1 76 : 45=1·69 : 1
≡ Pondichéry. Etang. Jardin Colonial	(40+18) : 18=3·22 : 1	70 : 43=1·63 : 1	66 : 26=2·54 : 1	41 : 21=1·95 : 1	66 : 41=1·61 : 1

TABLEAU III (fin).

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Villénour. Etang	(48+18) : 21=3·14 : 1	83 : 51=1·63 : 1	68 : 26=2·62 : 1	45 : 28=1·6 : 1	68 : 45=1·51 : 1
Ootacamund. Lac	(47+21) : 21=3·24 : 1	76 : 50=1·4 : 1	75 : 26=2·88 : 1	51 : 28=1·82 : 1	75 : 51=1·47 : 1
	(43+20) : 20=3·15 : 1	76 : 50=1·4 : 1	68 : 25=2·72 : 1	50 : 28=1·78 : 1	68 : 50=1·36 : 1
	(46+20) : 20=3·3 : 1	50 : 43=1·16 : 1	70 : 26=2·69 : 1	53 : 33=1·6 : 1	70 : 53=1·32 : 1
	(43+20) : 19=3·32 : 1	73 : 53=1·38 : 1	68 : 30=2·27 : 1	40 : 25=1·6 : 1	68 : 40=1·7 : 1
	(48+18) : 21=3·14 : 1	75 : 53=1·42 : 1	76 : 30=2·53 : 1	51 : 31=1·65 : 1	76 : 51=1·49 : 1
	(57+23) : 21=3·8 : 1	68 : 51=1·33 : 1	81 : 30=2·7 : 1	50 : 31=1·61 : 1	81 : 50=1·62 : 1
Moyenne	(47·33+20·33) : 20·33=3·33 : 1	69·67 : 50=1·39 : 1	73 : 27·83=2·62 : 1	49·17 : 29·33=1·68 : 1	73 : 49·17=1·49 : 1
Kodaikanal. Lac	(49+21) : 18=3·89 : 1	81 : 58=1·39 : 1	75 : 26=2·88 : 1	50 : 31=1·61 : 1	75 : 50=1·5 : 1
	(45+21) : 18=3·67 : 1	76 : 53=1·43 : 1	75 : 28=2·68 : 1	46 : 28=1·64 : 1	75 : 46=1·63 : 1
Kodaikanal. Bassin près d'une chute d'eau	(52+18) : 19=3·68 : 1	83 : 48=1·73 : 1	70 : 28=2·5 : 1	50 : 31=1·61 : 1	70 : 50=1·4 : 1

TABLEAU IV.

M. varicans var. *subaequalis*.

Localité.	Furca. Longueur : largeur.	Furca. Soie apic. int. : soie apic. ext.	Art. term. enp. 4. Longueur : largeur.	Art. term. enp. 4. Ep. int. : ép. ext.	Art. term. enp. 4. Long. art. : long. ép. int.
Pandharpour. Rivière Takli	(60+23) : 23=3·6 : 1	85 : 58=1·46 : 1	66 : 35=1·89 : 1	50 : 28=1·78 : 1	66 : 50=1·32 : 1
	(49+21) : 18=3·89 : 1	81 : 41=1·97 : 1	68 : 28=2·43 : 1	51 : 34=1·5 : 1	68 : 51=1·33 : 1
	(50+20) : 18=3·89 : 1	71 : 50=1·42 : 1	66 : 28=2·36 : 1	53 : 31=1·71 : 1	66 : 53=1·25 : 1
Pandharpour. Etang	(52+23) : 19=3·95 : 1	80 : 45=1·78 : 1	70 : 25=2·8 : 1	58 : 35=1·66 : 1	70 : 58=1·2 : 1
	(52+21) : 18=4·05 : 1	80 : 48=1·67 : 1	68 : 28=2·43 : 1	56 : 33=1·69 : 1	68 : 56=1·21 : 1
	(52+21) : 18=4·05 : 1	92 : 50=1·84 : 1	66 : 28=2·36 : 1	58 : 31=1·87 : 1	66 : 58=1·14 : 1
	(58+25) : 18=4·61 : 1	85 : 56=1·52 : 1	65 : 31=2·09 : 1	48 : 26=1·85 : 1	65 : 48=1·35 : 1
	(58+23) : 18=4·5 : 1	113 : 50=2·26 : 1	65 : 30=2·17 : 1	53 : 35=1·51 : 1	65 : 53=1·23 : 1
Moyenne	(54·4+22·6) : 18·2=4·23 : 1	90 : 49·8=1·8 : 1	66·8 : 28·4=2·35 : 1	54·6 : 32=1·68 : 1	66·8 : 54·6=1·22 : 1
Ellora. Ruisseau	(48+20) : 20=3·4 : 1	83 : 50=1·66 : 1	66 : 30=2·2 : 1	50 : 27=1·85 : 1	66 : 50=1·32 : 1
	(48+20) : 20=3·4 : 1	83 : 50=1·66 : 1	66 : 27=2·44 : 1	50 : 26=1·92 : 1	66 : 50=1·32 : 1
Ellora. Réservoir	58 : 18=3·22 : 1	....	75 : 28=2·68 : 1	51 : 29=1·76 : 1	75 : 51=1·47 : 1
Ramling. Mare	(57+23) : 22=3·63 : 1	85 : 66=1·28 : 1	70 : 31=2·26 : 1	45 : 25=1·8 : 1	70 : 45=1·56 : 1
	(50+25) : 20=3·75 : 1	83 : 58=1·43 : 1	66 : 31=2·13 : 1	43 : 25=1·72 : 1	66 : 43=1·53 : 1
	(58+25) : 21=3·95 : 1	83 : 55=1·5 : 1	70 : 31=2·26 : 1	48 : 25=1·85 : 1	70 : 48=1·46 : 1
	(60+20) : 20=4 : 1	83 : 50=1·66 : 1	66 : 31=2·13 : 1	48 : 24=2 : 1	66 : 48=1·37 : 1

TABLEAU V.

M. davidi var. *subtropicus*.

Localité.	Furca. Longueur : largeur.	Furca. Soie. ap. int. : soie apic. ext.	Enp. 4. Long. : largeur.	Enp. 4. Epine. int. : ép. ext.	Enp. 4. Long. art. : ép. int.	Cinquième patte. Art. Long. : larg.
Grottes Kanhéry. Citerne	(48+20) : 25=2.72 : 1	125 : 68=1.84 : 1	..	58 : 33=1.76 : 1	....	18 : 5=3.6 : 1
	(44+20) : 23=2.78 : 1	116 : 66=1.76 : 1	..	53 : 36=1.47 : 1	....	18 : 6=3 : 1
Lac Povaï. Mare	(30+20) : 23=2.17 : 1	83 : 66=1.26 : 1	65 : 25=2.6 : 1	48 : 33=1.45 : 1	65 : 48=1.35 : 1	20 : 5=4 : 1
Lac Povaï. Rivière	(35+18) : 23=2.3 : 1	98 : 58=1.69 : 1	61 : 28=2.18 : 1	50 : 33=1.52 : 1	61 : 50=1.22 : 1	22 : 8=2.7 : 1
	(33+20) : 21=2.52 : 1	..	66 : 29=2.27 : 1	50 : 33=1.52 : 1	66 : 50=1.32 : 1	25 : 8=3.1 : 1
Lac Povaï. Etang	(35+18) : 25=2.12 : 1	116 : 60=1.83 : 1	65 : 28=2.32 : 1	50 : 35=1.43 : 1	65 : 50=1.3 : 1	20 : 6=3.3 : 1
Lac Véhar. Mare	(35+15) : 21=2.38 : 1	108 : 50=2.16 : 1	63 : 26=2.42 : 1	41 : 28=1.46 : 1	63 : 41=1.54 : 1	25 : 5=5 : 1
Ghatkopar. Rivière	(36+22) : 22=2.64 : 1	83 : 50=1.66 : 1	66 : 26=2.54 : 1	46 : 33=1.39 : 1	66 : 46=1.43 : 1	25 : 6=4.1 : 1
Kodaikanal. Lac	(35+21) : 20=2.8 : 1	81 : 58=1.39 : 1	60 : 26=2.3 : 1	50 : 36=1.39 : 1	60 : 50=1.2 : 1	21 : 6=3.5 : 1
	(35+20) : 20=2.75 : 1	91 : 60=1.52 : 1	. ..	....	....	....
Kodaikanal. Bassin d'une chute d'eau	(25+23) : 20=2.4 : 1	101 : 60=1.68 : 1	66 : 28=2.36 : 1	52 : 38=1.37 : 1	66 : 52=1.27 : 1	28 : 8=3.5 : 1

A STUDY OF VARIATIONS IN *BARBUS (PUNTIUS) TICTO* (HAMILTON).

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INTRODUCTION.

In studying several collections of freshwater fishes from India and Burma Hora found considerable variations in the specific characters usually relied upon for the determination of Hamilton's¹ *Cyprinus (Puntius) ticto*. Though he² recently made an attempt to give the diagnostic features of *Barbus (Puntius) stoliczkanus* Day, a form closely allied to *B. ticto*, a collection from Dalu, in the Upper Chindwin drainage, showed that those characters were not of much use in separating the two species. Moreover, the specimens of *B. ticto* from Peninsular India³ were found to exhibit gradations between the two forms, while Day's⁴ *B. punctatus* from South India appeared to be identical with the Burmese *B. stoliczkanus*.

We may here quote from a communication received from Dr. H. M. Smith to whom a named example of *B. stoliczkanus* from Sandoway,

¹ Hamilton, F., *Fish. Ganges*, pp. 314, 389, pl. viii, fig. 87 (1822).

² Hora, S. L., *Rec. Ind. Mus.* XXXIX, p. 330 (1937).

³ Hora, S. L. and Misra, K. S., *Journ. Bombay Nat. Hist. Soc.* XL, p. 28 (1938); Hora, S. L., *Rec. Ind. Mus.* XL, p. 240 (1938).

⁴ Day, F., *Proc. Zool. Soc. London*, p. 302 (1865).

Burma, was sent in exchange for comparison with his Siamese material. He wrote as follows :—

“ The receipt of the specimen of *Puntius stoliczkanus* from Lower Burma has permitted the identification as that species of numerous examples from Northern Siam (Mepin basin) and Western Siam (Salwin basin).”

Dr. Smith's statement brought to our mind the distribution of Hamilton's *Cyprinus cosuatus* (= *Oreichthys cosuatus*)¹ and it occurred to us that in *Barbus ticto* we have probably a species which is found over a wide area, and which exhibits certain morphological variations in different types of environments encountered in its wide range of distribution. To test this hypothesis a number of characters were tabulated in a large series of specimens from different parts of India and Burma. As a result of these studies it is now definitely established that Day's *stoliczkanus* and *punctatus* cannot be regarded as distinct species, but should be merged in the synonymy of *B. ticto*. Though in the tables (*vide infra*, pp. 274-279) measurements, scale counts, etc., of only a limited number of specimens are given, the actual material examined has been very considerable. Unfortunately, it has not been possible to examine any specimen of *B. ticto* from the Punjab and Sind, but all the same the results given below seem to be fairly conclusive.

HISTORICAL.

Cyprinus (Puntius) ticto was described by Hamilton (*op. cit.*) from “ the south-east parts of Bengal ” ; he referred to its strong resemblance with *Cyprinus (Puntius) sophore* and noted that it “ wants the golden mark on the gill-covers, and seldom is found above two inches long ”. Among the diagnostic features of the species he directed attention to “ one black spot on the lateral line above each pectoral fin, and another near the end of the tail ; and with the back fin spotted, and its second ray indented behind ” He further noted that “ in old individuals, the dorsal, anal, and ventral fins are slightly stained with red ; the dorsal is marked with two rows of dark spots ” The absence of barbels was noted and the lateral line was characterised as “ scarcely distinguishable ”

In his account of *Cyprinus (Puntius) titius* (p. 315), a species characterised by the possession of a smooth dorsal spine, Hamilton remarked as follows :—

“ In the north-east parts of Bengal I saw another fish called by the same name, and procured a drawing, now in the possession of the Bengal Government. It differed in a few particulars from the Ticto, but, the drawing being sufficient to point out the difference, I took no notes, and therefore, until I recover the drawings, I cannot give this fish a specific character, although I call it *Tictis*. ”

Hamilton's original drawing of the form *tictis* was reproduced by Hora,² and a comparison of this figure with Hamilton's figure of *ticto* brings out the following points of differences :—

i. The Dorsal fin of *tictis* is better developed and more extensive ; the dorsal spine is longer than the head and very coarsely serrated internally. In *ticto* the dorsal spine is shorter than the head and finely serrated.

¹ Hora, S. L., *Rec. Ind. Mus.* XXXIX, p. 321 (1937).

² Hora, S. L., *Mem. Ind. Mus.* IX, pl. xxiii, fig. 6 (1929).

ii. The anterior dark spot is much closer to the head in *tictis* than that of *ticto*. The gill-membrane and the area between operculum and preoperculum are stained with black in *ticto*, while this is not so in *tictis*. Moreover, the dorsal fin of *ticto* is marked with two rows of spots which are absent in *tictis*.

iii. The shape of the fins is somewhat different in the two forms.

iv. The body is proportionately deeper in *tictis* than in *ticto*.

The value of some of the characters tabulated above is discussed below (pp. 267-270) and it is surmised that the form *tictis* probably represents the males of *ticto*.

McClelland¹ referred Hamilton's *ticto* to his genus *Systomus* and gave the number of scales along the lateral line as 24 and "eight in depth from the base of the dorsal to the ventral on either side" McClelland states that "A variety of this species with two rows of dots on the dorsal is figured by Buchanan as *Cyp. bimaculatus*, but as it has two black spots on each side, it should rather have been named *quadrimaculatus*". McClelland seems to have confused the drawing of *tictis* with *ticto*, for the illustration of the latter species published by Hamilton himself shows two rows of spots on the dorsal fin. Moreover, *Cyprinus bimaculatus*, which was described by Hamilton in manuscript while stationed near Calcutta, has been shown to be *ticto* by Hora.²

Probably on account of the serrated nature of the dorsal spine, and the deep body, Sykes³ referred *Cyprinus ticto* to his genus *Rohtee*, but as *ticto* is provided with a short anal fin it cannot belong to that genus. Sykes found this species in the "Mota Mola river, at Poona" and noted that the fish is provided "with from 4 to 6 black spots on the body, made up of minute dots; one small spot above each pectoral fin, one larger one is situated on the tail, above the last anal ray, and one minute spot, sometimes wanting, near the base of the first dorsal ray" His examples were $1\frac{1}{2}$ inches long and in them the lateral line was very obscure.

Jerdon⁴ included a large number of species of South Indian Minnows in the genus *Systomus*, but it is difficult to define their precise specific limits without a fresh collection of topotypes. Regarding *ticto* he observed that "This may be an *Opsarius*" However, he does not seem to have examined any specimen of the species. Day⁵ assigned *S. tripunctatus* Jerdon to the synonymy of *ticto*. The specimens of *S. tripunctatus* were obtained by Jerdon in a small stream near the coast in Canara and are noted to possess "2 black spots under end of dorsal, and another at base of tail" The colouration of the species is against its having any relationship with *ticto*.

In 1865, Day⁶ described a new Carp Minnow from Cochin as *Puntius punctatus* and characterized it by the possession of a serrated dorsal spine

¹ McClelland, J., *As. Res.* XIX, p. 382 (1839).

² Hora, S. L., *Journ. As. Soc. Bengal*, (N. S.) XXVII for 1931, p. 135 (1933).

³ Sykes, W. H., *Trans. Zool. Soc. London*, II, p. 365 (1841).

⁴ Jerdon, T. C., *Madras Journ. Lit. Sci.* XV, pp. 314-319 (1849).

⁵ Day, F., *Fish. India*, p. 576 (1877).

⁶ Day, F., *Proc. Zool. Soc. London*, p. 302 (1865).

and complete lateral line. He described the colouration of the species as follows :—

“ Olive-green above, gradually fading into silvery on the abdomen. A black diffused spot on the twentieth and twenty-first scales of the lateral line. The anterior half of the fourth scale from the operculum, of the row next below the lateral line, deep black, and also a portion of the scale above and beneath it. Fins yellowish. Dorsal and anal tipped with orange. Dorsal spotted with black, in two longitudinal rows, with a third in the front part between the other two. The dark markings are much more visible in the months when the freshes are coming down.”

The colouration of the dorsal fin is similar to that shown by Hamilton for his *Cyprinus tictis* (*vide supra*, p. 265) and, as the colours are stated to be better marked during the monsoon months, it would appear that *B. tictis* probably represents the male of *B. ticto*. As both the colouration and the extent of the lateral line are found to be variable characters in *B. ticto*, we have not found it possible to recognise *B. punctatus* as a distinct species. So far as we are aware this form has not been recorded again since Day's time. *Systomus conchoni* Jerdon¹ (*nec* Hamilton) appears to be a doubtful synonym of Day's *B. punctatus* (= *B. ticto*). It may be noted that *B. conchoni* has not yet been recorded from Peninsular India.

Günther² placed *ticto* in the genus *Barbus* and doubtfully assigned *Rohtee ticto* Sykes to its synonymy. He redescribed the species from 12 specimens, including 2 “ Adult : not in good state. Dekkan. From Colonel Sykes' Collection ”, and gave as its habitat Bengal, Assam and the Himalayas. In his description he pointed out that the osseous dorsal ray is of moderate strength and serrated, the lateral line is incomplete and the fish is provided with “ A small black spot on the commencement of the lateral line, another larger one on the lateral line, immediately behind the anal fin. Upper two-thirds of the dorsal fin black ”

In 1869, Day³ described *Barbus m'Clellandi* from Burma (Pegu and Moulmein) and noted that

“ This species bears a strong resemblance to the *B. ticto*, H. B., which it appears to supersede in Eastern Burma. But it is distinguished by a complete instead of incomplete lateral line, and its body is not so compressed ; its dorsal spine and colouring also differ”.

In his “ Monograph of the Indian Cyprinidae ”, he⁴ changed the name of the species to *Barbus (Puntius) stoliczkanus* and in the description the proportion of the head to the length of the fish gave as $\frac{1}{6}$ instead of $\frac{1}{5}$. In the *Fishes of India* the species is described and figured from Eastern Burma, but it is noted that “ Some Darjeeling examples agree with the Burmese fish ”

Since Day's time *B. stoliczkanus* has been recorded from Burma by Boulenger⁵ (S. Shan States), Chaudhuri⁶ (Putao Plains) and Hora⁷ (Sandoway). In the case of the specimens from Fort Stedman, Boulenger remarked that “ the anterior black spot is absent or indistinctly

¹ Jerdon, T. C., *Madras Journ. Lit. Sci.* XV, p. 317 (1849).

² Günther, A., *Cat. Fish. Brit. Mus.* VII, p. 153 (1868).

³ Day, F., *Proc. Zool. Soc. London*, p. 620 (1869).

⁴ Day, F., *Journ. As. Soc. Bengal*, XL, p. 328 (1871).

⁵ Boulenger, G. A., *Ann. Mag. Nat. Hist.* (6) XII, p. 202 (1893).

⁶ Chaudhuri, B. L., *Rec. Ind. Mus.* XVI, p. 283 (1919).

⁷ Hora, S. L., *Rec. Ind. Mus.* XXXIX, p. 330 (1937).

indicated". Basing his observations on young specimens from Sandoway Hora relied on the number of predorsal scales in separating *ticto* from *stoliczkanus*. He found considerable variation in the extent of the lateral line. Though Day mainly relied on the extent of the lateral line in separating the two species, he¹ refers to a specimen of *ticto* from Calcutta with the "lateral-line distinct for 6 scales, indistinct for 10 more, when it ceases"². He further observed that in *B. ticto* "Cutch examples have 23 to 25 scales along the lateral-line, and one specimen had two blotches on either side of the base of the caudal fin. In Sind the dorsal spine is thin and very finely serrated. One Ganjam example had L. 1.27, as had also one from Bheer Bhoom. In Orissa they had as a rule L. 1.25, in the Wynaad L. 1.23" Hora and Misra³, and Hora⁴ found the lateral line in *B. ticto* extending over 10 to 12 scales; they also observed well-marked sexual dimorphism with regard to colouration; the specimens with coloured dorsal and anal fins were found to be males. Just before full maturity the dorsal fin of the male becomes marked with two or more rows of black spots till finally the entire fin assumes that colour. Annandale⁵ described melanic specimens of what he considered to be *B. ticto* from Rajsbahi District, Bengal, and compared them with the normal paler individuals collected from the same place at the same time. We have examined these specimens and find them to belong to *B. conchoni* (Ham.); the two melanic individuals, about 81 mm. in length, are males, while the four paler individuals, about 68 to 76 mm. in length, are females.

Variation in the colouration of the Punjab examples are described by Fowler⁶ as follows :—

"Variation seen in the Himalayan examples, in black at tip of dorsal, ventral and anal, absent in 2 examples. Black blotch above anal usually present and only evident in young just behind shoulder. Smaller and young from Loodianali with shoulder-spot more conspicuous, also some with 2 oblique dark bars on dorsal. The largest examples from Kalla Weddee, with the tubes of lateral line on 6 to 8 scales. Ends of dorsal and anal, and all of ventrals, jet black, also scale-edges narrowly with vertical blackish margin, even to those along edge of preventral region".

In the above account we have referred to the variations observed in *B. ticto* by the previous writers, and in the following pages we propose to give a detailed account of the variations undergone by some of the salient diagnostic features of the species.

MORPHOLOGICAL.

Dorsal spine.—It is not possible to tabulate the variations observed in the nature of the dorsal spine, which, as a rule, is moderately strong and serrated, but in some individuals, especially from the hilly areas, it is feeble and the number of teeth along its posterior border is small.

¹ Day, F., *Fish. India*, p. 577 (1877).

² We have examined this specimen which is now preserved in the collection of the Indian Museum.

³ Hora, S. L. and Misra, K. S., *Journ. Bombay Nat. Hist. Soc.* XL, p. 28 (1938).

⁴ Hora, S. L., *Rec. Ind. Mus.* XL, p. 240 (1938).

⁵ Annandale, N., *Rec. Ind. Mus.* I, p. 81 (1907).

⁶ Fowler, H. W., *Proc. Acad. Nat. Sci. Philadelphia* LXXVI, p. 86 (1924).

In this connection attention may be invited to an interesting observation made by Day¹ regarding *Barbus conchoni* (Ham.). He observed that—

“Nainee tal specimens have the dorsal spine much less coarsely serrated than those from the plains, from whence they were introduced not many years since; they have also a darkish band along the side.”

It is very difficult to assign any definite reason for the relative weakness of the spine in specimens from the hills, but it seems quite possible that in pools and puddles on the hills there is probably less competition for existence than in the case of the plain-dwelling forms, and in consequence the protective armature is more or less feebly developed. In this connection it may also be noted that in the Siluroid fishes of the plains, especially of the muddy waters, the dorsal and the pectoral spines are well developed, while the same structures are feebly developed in the hill-stream forms.

Lateral line.—With the exception of the 3 specimens from Sandoway in Lower Burma, 5 specimens from the Sittang river below Pegu, 6 specimens from Beeling near Pegu, one specimen from the Putao Plain and one specimen of *B. punctatus* from Madras, the lateral line is incomplete in all the other examples studied by us. In the majority of the specimens it ceases after 5-7 scales, but in some it extends up to the 21st scale. The extent of the lateral line very frequently varies even on two sides of the same fish. In quite a number of cases the lateral line is interrupted for a scale or two; and is usually faintly marked towards its termination.

From the information so far available it seems that the lateral line is usually complete in the Burmese examples (specimens of *B. stoliczkanus* reported so far: Day's 6 specimens from Pegu and 15 from Moulmein; Boulenger's ? specimens from S. Shan States; Chaudhuri's 1 specimen from Putao Plains and Hora's 3 specimens from Sandoway) and certain examples from South India (*Puntius punctatus* Day). In two specimens from Pagoda Twante the lateral line extends up to the 18th and the 21st scale respectively. In one specimen from Sandoway the lateral line extends over 17 scales and in another only up to the 5th scale on one side and the 7th scale on the other. In 3 specimens from Dalu, Myitkyina District (Upper Chindwin drainage), the lateral line extends up to the 7th scale and its extent sometimes varies on two sides of the same specimen.

From Dr. H. M. Smith's observations referred to above (p. 264), it seems likely that in the Siamese specimens of the species the lateral line is invariably complete.

From Assam we have examined specimens from the Naga Hills, Mangaldai, Shillong and Goalpara. The extent of the lateral line varies from the 6th to the 11th scale, and in some specimens it varies even on the two sides of the same specimen. In Bengal specimens the lateral line may extend up to 14 scales.

In the Bihar examples (Saran, Hazaribagh District and Chota Nagpur), the lateral line extends from the 6th to the 9th scale, while

¹ Day, F., *Fish. India*, p. 576 (1877).

in 2 specimens from Orissa the lateral line is present on 8 and 10 anterior scales respectively.

In specimens from the United Provinces (Naini Tal, Bhim Tal and Dehra Dun), the lateral line extends over 6 to 10 scales. Its extent frequently varies on two sides of the same fish. In the two Peshawar examples the lateral line ceases after the 6th scale. From the Central Provinces we have examined specimens from the Narbada river (Rewa State, Ramgarh, Mandla, etc.) and the Bastar State; the lateral line is generally more extensive and may be present on 12 anterior scales.

From Peninsular India we have examined large series of specimens from a number of localities. In specimens from Deolali and Poona (Western Ghats) the lateral line is considerably more extensive and is present on 9 to 16 scales. In one specimen from Poona the lateral line is continued after 2 interruptions up to the 21st scale. In the examples from the Eastern Ghats the lateral line, as a rule, is present on 7 to 8 scales, but in certain specimens it extends, with interruptions, up to the 14th scale. In the specimens from the Coorg and the Mysore States its extent varies from 6 to 8 scales, while, according to Deraniyagala¹, in the Ceylon specimens the lateral line may extend up to the 15th scale, though in a few specimens examined by us it was found to be present only on 7 scales.

Judging from the variations noted above in the extent of the lateral line it seems that this character is undergoing retrogression and that it cannot be employed for the separation of varieties or races. Though, as a rule, the lateral line is complete in the Burmese examples, a number of individuals have been found in which the lateral line is very short. Further, specimens with extended or complete lateral line have also been found in South India.

Number of Predorsal Scales.—Hora² attached great importance to the number of predorsal scale in separating the Burmese species *stoliczkanus* from the Indian form *ticto*, but a detailed study of the character has shown that specimens from India show considerable variation in this respect. The Burmese examples, however, do not exhibit much variation in the number of predorsal scales as in 14 out of 16 specimens the number of predorsal scales is 9, while in the remaining 2 specimens, one from Sandoway and one from Beeling, it is only 8. In specimens from India, the number varies from 9 to 12, though the common number is 11. The specimens from Shimoga and Coorg, however, form an exception as the usual number of predorsal scales in them is 9 or 10. According to Deraniyagala (*op. cit.*), there are only 8 or 9 predorsal scales in the Ceylonese examples. In this respect the South Indian and Ceylonese specimens show a distinct affinity to specimens from Burma.

Length of head.—In his *Fishes of India* Day gives the proportion of the length of the head to the total length as $\frac{1}{5}$ in *B. ticto* and $\frac{1}{6}$ in *B. stoliczkanus*. In the original description of the latter species, however, he³ gave it as $\frac{1}{5}$ and not $\frac{1}{6}$. Similar discrepancies are to be found in Day's

¹ Deraniyagala, P. E. P., *Ceylon Journ. Sci.* (B) XVI, p. 21 (1930).

² Hora, S. L., *Rec. Ind. Mus.* XXXIX, p. 330 (1937).

³ Day, F., *Proc. Zool. Soc. London*, p. 619 (1869); *vide* description of *Barbus McClellandii*.

earlier and later descriptions of *Barbus (Puntius) punctatus*. In the specimens that we have examined the length of head is contained from 3.1 to 4.1 times in the length without the caudal, but in a majority of the specimens the proportion varies from 3.3 to 3.6. The length of the head varies considerably with the length or age of the specimens ; it is proportionately longer in smaller individuals than in the larger ones. In this respect we have not found much difference between the Burmese and Indian examples. Attention may, however, be directed to the fact that according to Deraniyagala the length of the head of the Ceylon examples is contained from 3 to 3.25 times in the standard length.

Depth of body.—The form of the body of a fish varies considerably according to whether it lives in swift currents, slow streams or stagnant waters (*vide* Hora¹). *Barbus ticto* is found in sluggish waters and pools of both hills and plains and the form of its body is, therefore, subject to considerable variation. In the specimens that we have examined it is contained from 2.3 to 3.0 times in the standard length, but in a majority of the individuals the proportion varies from 2.4 to 2.6. The specimens collected from clear waters of hill-streams are, as a rule, narrower and more graceful.

Colouration.—The colouration in fishes varies according to the age, sex and habitat of a fish and the variations in colour that we have noticed in the case of specimens of *B. ticto* from different localities can be readily explained. We have referred above (p. 267) to the melanic colouration of the males during the breeding season ; the extent of this secondary sexual feature is different in different individuals at various seasons of the year. A black mark at the commencement of the dorsal fin is present only in very young specimens, usually below one inch in length. It fades away in older individuals. The two characteristic lateral spots of the species are fairly well marked in young specimens up to about 1½ to 2 inches in length, but with growth the anterior spot gradually disappears. The anterior spot, when present, extends over 3rd and 4th scales of the lateral line. In some individuals it is somewhat oblong so that when its upper portion fades away, it is represented by a spot below the lateral line. The position of the posterior spot is somewhat variable, probably in accordance with the number of scales in the lateral line. As a rule it covers 2 to 3 scales (16th to 18th) but may extend over a few more of the posterior scales. Sometimes it is only present on the 18th and 19th scales and in very rare cases it extends to the 20th scale. In some large individuals the posterior spot may be faintly marked or totally absent.

As in the case of other freshwater fishes, the Burmese examples are, as a rule, more brilliantly coloured, and in this respect the South Indian specimens from Coorg and Shimoga show greater affinity to the Burmese than to the Indian examples.

GEOGRAPHICAL DISTRIBUTION.

Judging from the variations undergone by the characters discussed above, it seems that *Barbus ticto* is a very variable species and

¹ Hora, S. L., *Journ. As. Soc. Bengal*, Science I, pp. 1-7 (1935).

that *Cyprinus tictis* Ham., *Puntius punctatus* Day and *P. stoliczkanus* Day should be included in its synonymy. Its range of distribution is here extended from India to Burma and Siam. From the records of fresh-water fishes so far available it seems that *B. ticto* is perhaps not so common in Burma and Siam, as it is in India. Though the Burmese examples are, as a rule, characterised by the possession of a complete lateral line and 8 to 9 predorsal scales, these features cannot be regarded as specific owing to the wide range of variations undergone by examples from India by these characters.

We have referred above to the similarity between examples of *B. ticto* from Burma and South India, especially with regard to the extent of the lateral line, number of predorsal scales and colouration. In this connection it is of particular interest to establish the identity of *B. stoliczkanus* Day with *B. punctatus* Day. We give below measurements, scale counts, position of colour spots, etc., in a specimen of the latter species and when these are compared with similar measurements, etc., of Burmese examples on page 274 it will be noticed that there is practically no difference between the two sets of specimens. The occurrence of the same form of *B. ticto* in Burma and Peninsular India lends further support to the view expressed by one¹ of us in recent years that the fresh-water fish-fauna of India is derived from the eastern countries and that in the distribution of hill-stream forms the once extensive Satpura trend of mountain chains played a very important part.

Measurements in millimetres, scale counts, and position of colour spots of a specimen of Barbus (Puntius) punctatus Day.

Standard length	..	..	..	48.5
Depth of body	..	..	..	18.5
Length of head	..			12.5
Length of snout		..	..	2.0
Diameter of eye				4.5
Interorbital distance	..	..	.	5.3
No. of scales along lateral line	..	..	..	26
No. of perforated scales	..	..	..	26
No. of predorsal scales	..	..	..	9
No. of scales between L. l. and base of pelvic fin			..	3½
Position of anterior black spot	..	..		3
Position of posterior black spot	..		..	20-21

BARBUS (PUNTIUS) TICTO (HAM.) AND ALLIED SPECIES.

Both in literature and in the large named collection in the Indian Museum we have found great confusion regarding the precise specific limits that have been assigned to *Barbus ticto* and to several other closely allied forms. Day² included 11 species in his group of *Barbus* characterised by the total absence of barbels and by the possession of an osseous and serrated dorsal ray. These are, (i) *Barbus apogon* (Kuhl) C. and V ; (ii) *B. ambassis* Day ; (iii) *B. conchoni* (Ham.) ; (iv) *B. ticto* (Ham.) ; (v) *B. stoliczkanus* Day ; (vi) *B. punctatus* Day ; (vii) *B. gelius* (Ham.) ;

¹ Hora, S. L., *Rec. Ind. Mus.* XXXIX, p. 255 (1937).

² Day, F., *Fish. India*, pp. 575-579 (1877).

(viii) *B. phutunio* (Ham.) ; (ix) *B. cumingii* Günther ; (x) *B. nigrofasciatus* Günther ; and (xi) *B. guganio* (Ham.). Of these, the first two possess more than 35 scales along the lateral line and can thus be readily distinguished from the remaining species in which the number of lateral line scales is below 30. *B. guganio* is so insufficiently characterised that it is not possible to define its precise specific limits. *B. stoliczkanus* and *B. punctatus* have been shown above to be synonyms of *B. ticto*. The remaining six species, among which considerable confusion prevails, can be distinguished with the help of the table on page 273.

From a study of the table it would seem probable that this group of species may have evolved from a common parental stock and that the present-day differences between them in the form of the body, the number of scales, the extent of the lateral line and colouration are the result of some kind of habitudinal segregation or isolation of the various forms. As detailed data regarding the bionomics of the different species are not available, it is not possible for us at this stage to say much about the probable ancestry of these species.

SUMMARY.

Attention is directed to the great range of variations exhibited by Hamilton's *Cyprinus* (*Puntius*) *ticto* in the nature of its dorsal spine, the extent of its lateral line, the number of predorsal scales, proportions and colouration. These characters, which have been tabulated in a large series of specimens from different parts of India and Burma, show gradations between different types hitherto regarded as distinct species. It is thus shown that Day's *Barbus punctatus* from Peninsular India and *B. stoliczkanus* from Burma cannot be regarded as distinct species but should be treated as synonyms of *B. ticto*. In the historical review comments are made on the various forms that have been found to be identical with *B. ticto*. In discussing the geographical range of the species special attention is directed to the fact that the Burmese and Siamese examples (*stoliczkanus*-type) show greater affinity to specimens from Southern India (*punctatus*-type). At the end a table of comparison between *B. ticto* and five other allied species is given and it is surmised that they may have evolved from a common parental stock along slightly divergent lines.

TABLE I.—*BARBUS (PUNTIUS) TICTO* (HAM.) AND ALLIED SPECIES.

<i>Barbus ticto</i> (Ham.).	<i>Barbus conchoni</i> (Ham.).	<i>Barbus gelius</i> (Ham.).	<i>Barbus phutunio</i> (Ham.).	<i>Barbus comingii</i> (Günth.).	<i>Barbus nigrofasciatus</i> (Günth.).
1. Height of body 3 to $3\frac{1}{2}$ in total length.	Height of body $2\frac{2}{3}$ in total length.	Height of body 3 to $3\frac{1}{2}$ in total length.	Height of body 3 to $3\frac{1}{2}$ in total length.	Height of body 3 in total length.	Height of body $2\frac{2}{3}$ in total length.
2. L.1. 22-26; complete or incomplete.	L.1. 24-28; incomplete, extending up to 18 scales.	L.1. 23-24; incomplete extending up to 5 or 6 scales.	L.1. 20-23; incomplete extending up to 3 or 4 scales.	L.1. 21; incomplete extending up to 4 scales.	L.1. 20-21; complete.
3. An anterior spot on 3rd or 4th scale (frequently absent). Posterior spot ranges between 16th to 20th scales.	Anterior spot absent posterior spot ranges between 17th to 20th scales.	A black band over tail somewhat anterior to base of caudal fin; another less distinct band behind base of that fin. A black spot passes across base of the anterior half of dorsal extending one-third the distance up the rays. A black band over the base of the anal which is highest in front.	A black band passing from the back to opposite the middle of pectoral fin; a second from the back to the posterior end of the base of anal, two other lighter bands pass downwards one from the anterior the other from the posterior extremity of dorsal. A black band down the centre of dorsal, another at base of caudal. In adults the pectoral band decreases in size whilst that on the dorsal fin breaks up into spots.	In colouration more or less similar to <i>B. phutunio</i> two dark vertical bands one descending to the pectoral, the second across the free portion of the tail.	A black band passing from eye to eye: body with 3 vertical bands, the first from the back to middle of pectoral fin; the second from base of dorsal to behind base of ventral, and the third across free portion of tail; dorsal, anterior portion of pelvics and outer edge of anal black.
4. Throughout India, Ceylon, Burma and Siam.	Assam, Lower Bengal, Orissa, Behar, N. W. F. Province, Punjab and Deccan (?).	Ganjam, Orissa, Bengal and Assam.	Ganjam, Orissa and through Bengal to Burma.	Ceylon	Southern Ceylon.

TABLE III.—*BARBUS (PUNTIUS) TICTO* (HAM.) FROM ASSAM.

Measurements in millimetres, scale counts and position of colour spots.

					Naga Hills.					Mangaldai, Garo Hills.			Shillong.				Goalpara.	
Standard length	..	..	..	..	29.0	24.0	23.5	29.0	20.0	34.0	33.0	26.0	43.0	42.5	27.0	30.0	26.0	22.0
Depth of body	..	..	..	..	10.0	9.0	9.0	10.0	7.8	14.0	14.0	10.0	15.0	16.0	10.0	10.0	10.0	8.0
Length of head	..	..	..	..	8.5	7.5	7.5	8.0	6.0	9.0	9.0	8.0	12.0	13.0	7.5	8.6	8.0	7.0
Length of snout	..	..	..	..	2.5	2.0	2.0	2.5	2.0	3.0	3.0	2.8	3.5	3.5	2.5	2.7	2.5	2.0
Diameter of eye	..	..	..	..	3.2	3.0	3.0	3.2	2.5	4.0	4.0	3.5	4.0	4.0	3.0	3.0	3.0	2.5
Interorbital distance	..	..	..	..	3.2	3.0	3.0	3.2	2.5	4.0	4.0	3.0	4.5	4.5	3.5	3.5	3.2	2.8
No. of scales along lateral line	..	..	..	..	22	22	23	22	23	23	23	23	22	22	22	22	26	27
No. of perforated scales	..	..	..	..	6	6	6	7	7	8	8	6	6	7	6	7	9	6
No. of predorsal scales	..	..	..	..	9	9	9	9	9	11	11	10	10	10	11	10	11	11
Position of anterior black spot	..	..	..	..	4	4	4	4	4	4	4	4	abs.	abs.	abs.	abs.	abs.	abs.
Position of posterior black spot	..	..	..	..	18	18	18	18	18	18	18	18	16	16	18	17	abs.	abs.

TABLE IV.—*BARBUS (PUNTIUS) TICTO* (HAM.) FROM BENGAL, BIHAR AND ORISSA.*Measurements in millimetres, scale counts and position of colour spots.*

			BENGAL.									BIHAR.							ORISSA.		
			Darjeeling.			Ranigunge.						Hazaribagh.			Saran District.				Chota-Nagpur.	Orissa.	Puri.
Standard length	..	..	39.0	36.5	33.0	50.0	44.0	49.0	43.5	37.0	34.0	38.0	38.0	40.0	37.0	38.0	31.0	33.0	26.0	36.5	32.0
Depth of body	..	..	16.0	15.0	14.0	21.0	18.0	21.0	18.0	15.0	13.5	15.0	14.0	17.0	16.0	15.0	12.0	14.0	10.0	14.0	13.0
Length of head	..	..	11.5	10.5	9.7	13.0	12.5	13.0	12.0	11.0	9.5	11.0	11.0	11.0	10.5	10.5	9.5	9.0	8.0	10.0	9.0
Length of snout	..	..	3.0	3.0	2.1	3.2	3.0	3.1	3.0	2.5	2.5	2.9	2.8	3.0	2.9	3.0	2.7	2.8	2.5	3.2	3.0
Diameter of eye	..	..	4.0	4.2	4.0	5.5	5.0	5.3	4.8	4.5	3.5	4.0	4.0	4.0	4.0	4.0	3.4	3.5	3.0	4.0	4.0
Interorbital distance	..	..	4.2	4.2	4.0	5.5	5.3	5.4	5.0	4.5	3.5	4.5	4.3	4.4	4.0	4.0	3.4	3.5	3.2	4.0	4.0
No. of scales along lateral lines	..		25	26	23	25	25	24	24	22	22	23	23	24	26	25	24	25	24	25	25
No. of perforated scales.	..		12	6	12	13	14	9	9	7	6	7	8	7	8	8	7	9	6	10	8
No. of predorsal scales	..		11	10	10	11	10	10	10	9	9	11	11	11	11	11	9	11	9	10	11
Position of anterior black spot	..		4	3	4	abs.	abs.	abs.	abs.	abs.	abs.	3	4	abs.	4	3	abs.	4	abs.	4	3
Position of posterior black spot	..		19	18	16	abs.	abs.	abs.	abs.	abs.	abs.	17	17	18	19	18	18	18	18	19	17

TABLE V.—*BARBUS (PUNTIUS) TICTO* (HAM.) FROM UNITED PROVINCES, N.-W. F. PROVINCE AND CENTRAL PROVINCES.

Measurements in millimetres, scale counts and position of colour spots.

					UNITED PROVINCES.					N.-W. F. PROVINCE.		CENTRAL PROVINCES.								
					Naini Tal.		Dehra Dun.		Bhim Tal.			Peshawar.		Mandla.		Bastar State.				Rewa State.
Standard length	..	..	..	..	29.5	41.5	44.0	43.0	40.0	33.0	36.5	24.0	26.0	41.0	51.0	56.0	35.0	49.0	41.5	39.0
Depth of body	..	..	..	..	11.5	16.5	18.0	16.5	16.5	14.0	14.5	9.0	10.0	15.0	21.0	22.0	14.0	18.5	16.5	15.0
Length of head	..	..	..	..	8.5	11.2	12.7	12.0	12.0	9.5	10.5	7.5	8.0	10.0	13.0	14.0	10.0	13.5	10.5	10.0
Length of snout	..	..	..	..	2.5	3.0	4.0	2.9	3.0	2.5	2.5	2.0	2.5	2.5	3.5	4.0	2.6	3.5	3.3	3.1
Diameter of eye	..	..	..	..	3.6	4.5	4.5	4.3	4.0	3.5	4.0	3.0	3.0	4.2	5.0	5.2	4.1	4.0	4.0	4.0
Interorbital distance	..	..	..	..	3.8	5.0	5.0	5.0	5.0	3.5	4.5	3.0	3.2	4.5	5.3	6.0	4.5	4.2	4.1	4.0
No. of scales along lateral line	..	..	..	..	26	23	23	24	23	24	25	23	23	23	22	23	24	22	22	22
No. of perforated scales	..	..	..	..	8	9	10	6	8	6	6	8	9	9	11	10	12	7	7	7
No. of predorsal scales	..	..	..	..	11	10	11	11	11	10	11	10	9	9	8	10	9	10	9	10
Position of anterior black spot	..	..	..	..	abs.	abs.	abs.	abs.	abs.	4	abs.	abs.	abs.	3	4	3	3	4	4	4
Position of posterior black spot	..	..	..	..	19	17	17	18	17	17	19	18	18	17	17	18	17	17	17	19

TABLE VI.—*BARBUS (PUNTIUS) TICTO* (HAM.) FROM EASTERN AND WESTERN GHATS.*Measurements in millimetres, scale counts and position of colour spots.*

				EASTERN GHATS.						WESTERN GHATS.								
				Cuddapah District, Ganjam river near Kodur.			Nallamalai Hills 800 ft. Mahanadi river.			Deolali.				Poona.				
Standard length	..	..	..	32.0	37.0	33.0	42.0	34.0	32.0	48.5	46.0	41.0	39.0	31.5	52.0	45.0	46.0	51.0
Depth of body	..	..	..	13.0	14.5	13.5	16.0	14.0	13.0	20.0	18.0	16.5	15.0	12.0	21.0	17.5	19.0	20.0
Length of head	..	..	..	9.0	10.0	9.0	12.0	9.5	9.0	13.0	12.5	12.0	11.5	9.0	13.5	13.0	13.0	14.0
Length of snout	..	..	..	2.6	3.0	2.9	3.2	3.0	2.9	3.4	4.0	3.5	3.0	2.8	3.5	3.3	3.3	3.5
Diameter of eye	..	..	..	4.0	4.0	4.0	4.5	4.0	4.0	4.5	5.0	4.0	3.8	3.4	4.5	4.5	4.5	4.5
Interorbital distance..	..	..	..	4.0	4.0	4.0	4.8	4.0	4.0	4.5	5.5	4.2	4.0	3.5	4.5	4.5	4.6	4.7
No. of scales along lateral line	..	..		24	23	24	25	24	24	25	23	25	26	25	23	25	24	25
No. of perforated scales	..	..		10	7	7	7	14	7	14	13	11	15	9	10	13	9	16
No. of predorsal scales	..	..		11	11	10	10	10	11	11	11	11	10	9	9	10	10	10
Position of anterior black spot	..	..		4	4	4	4	4	4	abs.	abs.	abs.	abs.	abs.	..	4	4	4
Position of posterior black spot	..	..		19	18	18	19	18	19	19	17	17	19	18	18	19	18	18

TABLE VII.—*BARBUS (PUNTIUS) TICTO* (HAM.) FROM SOUTH INDIA AND CEYLON.*Measurements in millimetres, scale counts and position of colour spots.*

		SOUTH INDIA.				CEYLON.	
		Shimoga.			Coorg State.		
Standard length	..	30.0	26.0	21.0	27.5	35.0	22.5
Depth of body	..	11.5	10.0	8.0	10.0	13.0	8.5
Length of head	..	9.0	8.0	6.5	8.0	10.5	7.0
Length of snout	..	2.0	2.0	1.9	2.0	2.0	1.5
Diameter of eye	..	4.0	3.0	2.5	3.0	3.8	2.6
Interorbital distance	..	4.0	3.0	2.5	3.0	3.8	2.6
No. of scales along lateral line.		23	23	23	23	22	22
No. of perforated scales	..	8	6	6	7	7	7
No. of predorsal scales	..	9	9	10	10	9	10
Position of anterior black spot.		4	4	4	4	3	4
Position of posterior black spot.		18	17	17	17	17	18

REPORT ON A COLLECTION OF BIRDS FROM THE BENGAL DUARS AND THE TISTA VALLEY MADE IN THE WINTER OF 1938, WITH NOTES ON SPECIMENS IN THE INDIAN MUSEUM.

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I. INTRODUCTION.

In November and December 1938 a party of the Zoological Survey of India under the leadership of Dr. S. L. Hora made a collection of bird skins from the Bengal Duars and the Tista Valley. The Director kindly placed the collection at my disposal for report. The birds in

the collection comprise 20 families, 30 genera and 32 species and subspecies. Departures, either in coloration or in measurements, from the recognised characters of the races have been described. Under each species, notes regarding its representation in the Indian Museum collections are given, and its distribution discussed, which in some cases has to be considerably extended on that basis.

The Bengal Duars and the Tista Valley lie at the base of the Himalayan Range and comprise a well-forested area studded with streamlets. The places visited lie in the Darjeeling and Jalpaiguri Districts, and since many of them are obscure and not shown in ordinary maps, their approximate geographical positions are given below. The spellings employed are those given in the latest (1936) Degree Sheets issued by the Survey of India Department.

LOCALITY.	LATITUDE.	LONGITUDE.
(A) <i>Darjeeling District</i> —		
1. Siliguri	26° 43' N.	88° 26' E.
2. Sivok Ghāt (on R. Tista, near Sivok Railway Station)	26° 52' N.	88° 29' E.
3. Naksalbāri	26° 40' N.	88° 12' E.
4. Khāribāri	26° 33' N.	88° 12' E.
(B) <i>Jalpaiguri District</i> —		
5. Eastern Bank of R. Tista (between Sivok and Bagrākot)	26° 52' N.	88° 32' E.
6. Mongpong (on R. Tista, near Sivok)	26° 53' N.	88° 32' E.
7. Gish (on R. Gish, near Forest Rest House)	26° 55' N.	88° 36' E.
8. Barrākhola	26° 55' N.	88° 47' E.

For each bird its Registered Number in the collections of the Zoological Survey of India (Indian Museum), the place and date of collection and its measurements (in millimetres) are given. The following abbreviations have been used throughout:—

No., Registered Number of specimen in the Zoological Survey of India (Indian Museum).

C., Length of culmen.

L., Total body length.

Tl., Length of tail.

Tr., Length of tarsus.

W., Length of wing.

For each species or subspecies, only two synonymies are given, *viz.*, the earliest reference, and a reference to Stuart Baker in the *Fauna Br. India, Birds* (2nd ed.), vols. I-VIII, 1922-30. In cases, however, where an important paper or monograph dealing with the species has appeared since Stuart Baker's work, the synonymy employed therein is also given. In regard to nomenclature, I have followed Stuart Baker throughout, except in cases where he has been definitely shown to be in the wrong.

I am greatly indebted to Dr. Bains Prashad, D.Sc., F.N.I., etc., Director, Zoological Survey of India, for ready counsel and much

kindness during the course of this work. To Mr. M. N. Acharji, M.Sc., Assistant in the Zoological Survey, my thanks are due for some assistance in the identification of the birds.

II. SYSTEMATIC ACCOUNT.

(A) Order PASSERES.

Suborder DIACROMYODI.

1. Family CORVIDAE.

Genus *Dendrocitta* Gould, 1833.

Dendrocitta vagabunda vagabunda (Latham), 1790.

(The Bengal Tree Pie.)

1790. *Coracias vagabunda*, Latham, *Index Ornith.*, p. 171. (India).

1922. *Dendrocitta rufa vagabunda*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) I, p. 50.

1932. *Dendrocitta vagabunda vagabunda*, Whistler & Kinnear, *Journ. Bombay Nat. Hist. Soc.* XXXV, p. 515.

No. 26403. ♀. (Khāribāri. Dec. 7, 1938.)

Measurements (mm.) :—L.-395 ; W.-150 ; Tl.-250 ; Tr.-35 ; C.-26.

Notwithstanding the revision of this Tree Pie by Stuart Baker¹, there remains a great deal of confusion in the recognition of the various Indian races. Stuart Baker distinguishes five races, viz., *rufa*, *vagabunda*, *saturator*, *kinneari* and *sclateri*. The differences on which some of these races are based are insignificant and unrecognisable. Ticehurst² recognises only three Indian races of this Tree Pie, viz., *vagabunda*, *pallida* and *saturator*. Kinnear & Whistler³ express their dissatisfaction with both groupings. They point out in a later communication⁴ that the name *Dendrocitta rufa* should be changed to *D. vagabunda* on the ground of name *rufus* being preoccupied. They divide *D. vagabunda* into four Indian races as follows :—*D. vagabunda vagabunda* Latham (Outer Eastern Himalayas, Nepal, Assam) ; *D. v. pallida* Blyth (Outer Western Himalayas, North-West Frontier Province, Punjab, Rajputana, Sind) ; *D. v. parvula* [*nom. nov.* for *Corvus rufus* Latham] (West Coast from South Kanara to Cape Comorin) ; and *D. v. vernayi* Kinnear & Whistler (South-East India south of the Godavari, South-East Hyderabad, Mysore and the Nilgiris). A preliminary examination of the fine series of skins in the Indian Museum does not fully support this division and suggests other complications, but pending a proper revision of the species, I tentatively adopt the four races of Kinnear & Whistler.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) I, pp. 48-51 (1922).

² Ticehurst, C. B., *Ibis* IV (11th Ser.), pp. 537, 538 (1922).

³ Kinnear, N. B. and Whistler, H., *Journ. Bombay Nat. Hist. Soc.* XXXIV, pp. 391, 392 (1930).

Whistler, H. and Kinnear, N. B., *Journ. Bombay Nat. Hist. Soc.* XXXV, pp. 514-516 (1932).

2. Family TIMALIIDAE.

Subfamily TIMALIINAE.

Genus **Mixornis** Hodgson, 1842.**Mixornis gularis rubricapilla** (Tickell), 1833.

(The Yellow-breasted Babbler.)

1833. *Motacilla rubricapilla*, Tickell, *Journ. Asiat. Soc. Bengal* II, p. 576. (Manbhum, East Bihar).1922. *Mixornis rubricapilla rubricapilla*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) I, p. 273. [Corrected to *M. gularis rubricapilla* in vol. VIII, p. 605 (1930).]

No. 26404. Unsexed (probably ♀). (Bengal Duars. Nov.-Dec., 1938.)

Measurements (mm.):—L.-119; W.-56; Tl.-53; Tr.-20.5; C.-11.

This bird is represented in the Indian Museum by some 21 skins from the following areas:—Nepal; Manbhum in East Behar; Assam; Chittagong in South Bengal; and from practically the whole of Burma including the Shan States, Bhamo and the Mergui Archipelago.

Three specimens of the Malayan race *M. g. pileata* obtained from Tenasserim (South Burma) and Perak (North Malaya Peninsula) are also present in the Indian Museum. They are easily distinguishable from the race *rubricapilla* by their deep chestnut-rufous crown and the heavier stripes on fore-neck and breast.

The race *M. g. minor* (Gyldenstolpe's Babbler), said to occur in Siam and Eastern Central Burma, is not represented in the Museum.

Subfamily LEIOTRICHINAE.

Genus **Aegithina** Vieillot, 1816.**Aegithina tiphia tiphia** (Linnaeus), 1758.

(The Common Iora.)

1758. *Motacilla tiphia*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 186. (Bengal).1922. *Aegithina tiphia tiphia*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) I, p. 340.

No. 26405. ♀. (Khāribāri. Dec. 6, 1938.)

Measurements (mm.):—L.-132; W.-65; Tl.-55; Tr.-17; C.-13.

The bird is represented in the Indian Museum by a fine series of some 73 skins obtained from Bengal, the United Provinces, Orissa, Ahmadabad in the Bombay Presidency, Assam, Burma including the Mergui area, and the Malay Peninsula.

It is also said to occur in Siam and Annam and in Khorasan (Iran), but is not found in North-Western India.

The allied Central Indian race *A. t. humei* Stuart Baker (1922) is also well represented in the Museum. Stuart Baker¹ gives its

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) I, p. 343 (1922).

distribution as follows:—South Central India, roughly embracing Southern and Western Rajputana, the Central Provinces and the United Provinces south of the Ganges. In the Museum we have specimens also from the Deccan including the Shevaroy Hills, Madura, Mangalore District and Travancore, which seem to belong to the race *humei*, so that the range given by Stuart Baker needs extension.

3. Family PYCNONOTIDAE.

Genus **Molpastes** Hume, 1873.

Molpastes cafer bengalensis Blyth, 1845.

(The Bengal Red-vented Bulbul.)

1845. *Molpastes bengalensis*, Blyth, *Journ. Asiat. Soc. Bengal* XIV, p. 566. (Bengal).

1922. *Molpastes haemorrhous bengalensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) I, p. 387. [Corrected to *Molpastes cafer bengalensis* in vol. VIII, pp. 613, 614 (1930).]

No. 26406. ♂. (Siliguri. Nov. 15, 1938.)

Measurements (mm.):—L.-196; W.-98; Tl.-100; Tr.-29; C.-16.

The bird here recorded has a blackish-brown plumage. The glossy black of the crown reaches the hind-nape and even fore-back and is not sharply defined from the dark brown of the back, unlike the race *burmanicus* in which the black not only does not extend to the hind-nape but is also sharply defined from the brown of the back. The black of the head below gradually shades into the blackish-brown of the fore-breast. The ear-coverts are glossy dark chocolate-brown. In wing length (98 mm.), however, the bird resembles *burmanicus* (W.—91 to 106 mm.) rather than *bengalensis* (W.—103 to 111 mm.) which is the largest Indian race of the species (Stuart Baker¹).

This race is represented in the Indian Museum by 44 specimens from the following areas:—Dehra Dun; the Nepal Valley; Darbhanga; Darjeeling; Calcutta; Dacca; and the Garo Hills, Sylhet, Cachar and Kobo in Assam. There is a male specimen (No. 3574) apparently belonging to this race from Bilaspur (Central Provinces?), but the date and the collector are unrecorded.

The closely allied race *M. c. burmanicus* is also well represented in the Museum, the birds having been obtained from Cachar (Assam), Shan States, Upper Burma, Mandalay and Arakan. There is an interesting albino specimen (No. 25431), apparently of this race, from Maymyo in Burma. This bird is pure white except for the red under-tail coverts, melanin being entirely suppressed; the beak and legs also do not contain any trace of black.

The other five Indian races of the Red-vented Bulbul, viz., *cafer*, *pallidus*, *nigripileus*, *chrysorrhoides* and *intermedius*, are also present in the Indian Museum collections.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) I, p. 388 (1922).

Genus **Elathea** Gestel, 1848.**Elathea jocosa emeria** (Linnaeus), 1766.

(The Bengal Red-whiskered Bulbul.)

1766. *Lanius emeria*, Linnaeus, *Syst. Nat.* (12th ed.) I, p. 137. (Bengal).1922. *Otocompsa emeria emeria*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) I, p. 394. [Corrected to *Elathea jocosa emeria* in vol. VIII, p. 614 (1930).]

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26407	♂	Eastern bank of R. Tista (between Sivok and Bagrākot).	Nov. 17	180	89	92	23	14
26408	♂	Gish	Nov. 22	180	93	88	25	13
26409	(?)	Barrākhola	Nov. 25	168	89	82	24	15
26410	♂	Khāribāri	Dec. 7	188	92	90	23	15

In all the four specimens the tips of the rectrices are pure white, sometimes touched with light grey ; they are not fulvous white as mentioned by Stuart Baker¹.

All the three Indian races of this bird, *viz.*, *emeria*, *fuscicaudata* and *peguensis*, are represented in the Indian Museum. Of the race *emeria* there are specimens from Bengal and from Manipur, South Sylhet and the Darrang District in Assam ; of *fuscicaudata* from South-Western Rajputana (Mt. Abu), Bombay Presidency (Khandalla) and South India (Shevaroy Hills, Ootacamund, Bhoura, South Mangalore and Travancore) ; and of *peguensis* from the Andamans (including the Viper Island), South-Western Burma (Arakan), Upper Burma (Shuaykoo, Bhamo and Ponsee ?), Central Burma (South Shan States), and South Burma (Moulmein, Mergui and Tenasserim). This distribution of *peguensis* slightly extends the northern range of the bird as defined by Stuart Baker² who does not include Bhamo.

Elathea flaviventris flaviventris (Tickell), 1833.

(The Black-crested Yellow Bulbul.)

1833. *Vanga flaviventris*, Tickell, *Journ. Asiat. Soc. Bengal* II, p. 573. (Dholbhum, South-East Bihar).1922. *Otocompsa flaviventris flaviventris*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) I, p. 397. [Corrected to *Elathea flaviventris flaviventris* in vol. VIII, p. 615 (1930).]

No. 26411. ♂. (Barrākhola. Nov. 24, 1938.)

Measurements (mm.) :—L.-184 ; W.-89 ; Tl.-95 ; Tr.-18 ; C.-14.¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) I, p. 395 (1922).² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) I, p. 397 (1922).

This bird is represented in the Indian Museum by an excellent series of 31 specimens from the following localities :—Nepal ; practically the whole of Assam and Burma, including Mergui and Tenasserim ; and from Pasighat in the Abors area in South Tibet (?). There are no specimens from Siam and Yunnan. The smaller race *minor*, said to occur in Peninsular Burma and Siam and throughout the Malay Peninsula, is not represented in the Museum.

4. Family TURDIDAE.

Subfamily BRACHYPTERYGINAE.

Genus *Heteroxenicus* Sharpe, 1902.

Heteroxenicus nipalensis nipalensis (Horsfield & Moore), 1854.

(The Nepal Short-wing.)

1854. *Brachypteryx nipalensis*, Horsfield & Moore, *Cat. Birds Mus. East India Coy.* I, p. 397. (Nepal).

1924. *Heteroxenicus nipalensis nipalensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 19.

No. 26412. Unsexed (probably ♀). (Gish. Nov. 22, 1938.)

Measurements (mm.) :—L.-122 ; W.-70 ; Tl.-45 ; Tr.-26 ; C.-16.

Unfortunately, the specimen is unsexed. I regard it as a probable female because of its ferruginous olive-brown upper plumage ; in the males the upper plumage is usually deep slate-blue. Stuart Baker¹ observes : “ Birds south of the Brahmaputra and in the extreme East of Assam only differ from those of the West in that the males are like the females and never put on the blue plumage except in very rare cases, and even then, as a rule, only partially ” Since the specimen recorded here was shot rather close to the above area, although to the west of it, the present probable sexing cannot be regarded with full satisfaction. Authentically sexed specimens are essential to determine the precise range of this interesting geographical variation in which one of the sexes (male in the present case) is alone affected.

Some remarks are necessary with regard to the status of *Heteroxenicus nipalensis*, *H. cruralis* and the monotypic *Brachypteryx major* as recognised by Stuart Baker². Ticehurst³ has very recently criticised Stuart Baker and expressed agreement with other writers who unite these three birds into a single genus with the specific names *nipalensis*, *cruralis* and *major*. In support of his contention Ticehurst states that Stuart Baker's sharp distinction between forms with shorter tarsi and longer tail (*Brachypteryx*) and those with longer tarsi and shorter tails

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, p. 19 (1924).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, pp. 9-21 (1924).

³ Ticehurst, C. B., *Ibis* III (14th Ser.), p. 349 (1939).

(*Heteroxenicus*) cannot be maintained because of intergradation, as shown by the following table :—

Species.	Percentage of tarsus to wing length.	Percentage of tail to wing length.
<i>major</i>	36-39	79-82
<i>cruralis</i>	40-47	65-74
<i>nipalensis</i>	41-46	56-61

It is of interest to note that the bird here recorded, which, because of colour and other characteristics, I regard as *H. nipalensis nipalensis*, shows a tarsus : wing percentage of 37 and a tail : wing percentage of 64. Thus, while in the latter respect it falls under the *nipalensis* or *cruralis* group of Ticehurst, in the former respect it belongs to the *major* group, showing thereby that much reliance cannot be placed on these percentages.

The conclusion of Ticehurst is shared by Rothschild¹, Robinson², and Delacour & Jabouille³. Nevertheless, for the sake of uniformity, I consider it preferable to follow Stuart Baker until a thorough revision of the Short-wings of India and "Greater India", which is greatly needed, is forthcoming.

The genus *Heteroxenicus* is very poorly represented in the Indian Museum collections. Of the five Indian species recognised by Stuart Baker⁴, only three are represented, viz., *H. nipalensis nipalensis*, *H. sinensis* and *H. stellatus*. Of *H. nipalensis nipalensis* there are five specimens (probably two males and three females) from Sikkim, Darjeeling, North Cachar, and Garo Hills. The upper plumage of an authentically sexed female (No. 22987) of *nipalensis* collected by E. C. S. Baker at Hungrum (North Cachar, Assam), on July 17, 1893, is warm russet-brown. A sexed male of *nipalensis* (No. 10492) from Sikkim has the whole of the upper plumage deep smoky-slate. Of *H. sinensis* there are only two unsexed specimens (both fulvous-brown and, therefore, apparently females), one from Cachar in Assam and the other from Ponsee (?) in Kahyen Hills, Upper Burma. Of *H. stellatus* there is only one specimen (No. 18326) from Ginatong in Sikkim.

Subfamily SAXICOLINAE.

Genus *Saxicola* Bechstein, 1802.

Saxicola torquata indica (Blyth), 1847.

(The Indian Bush-Chat.)

1847. *Pranticola indica*, Blyth, *Journ. Asiat. Soc. Bengal* XVI, p. 129. (India, Calcutta).

1924. *Saxicola torquata indica*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 28.

¹ Rothschild, Lord, *Novitat. Zool.* XXXIII, p. 270 (1926).

² Robinson, H. C., *Birds Malay Penin.* II, p. 220 (1928).

³ Delacour, J. and Jabouille, P., *Oiseaux l'Indochine Française* III, p. 100 (1931).

⁴ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, pp. 16-21 (1924).

[No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26413	♂	Mongpong	Nov. 17	122	72	57	24	10
26414	♀ (?)	Naksalbāri	Dec. 2	122	69	53	24	11

The bird No. 26414, given here as “♀ (?)”, was sexed as a male by the collector. In plumage and other characters it agrees closely with the female of *Saxicola torquata indica*, and I think the sexing of it as a male was probably a mistake.

S. t. indica has a wide distribution in India, extending from the Himalayas in the north to Mysore in the south. It breeds in the Himalayas, Western Siberia, Transcaspia, Turkestan and Iran, and visits the Indian plains only in winter. The bird is represented in the Indian Museum by a fine series of over 100 specimens from all over the North Indian range; there are no specimens from the southern range (Mysore, Travancore, Andaman Islands) of the bird. A few specimens from Chitral, Yarkand, Afghanistan and Transcaspia do not seem to differ from the birds recorded from India proper.

Other Indian races of this species, viz., *przewalskii*, *stegnegeri* and *leucura*, are poorly represented in the Museum.

Subfamily PHOENICURINAE.

Genus **Chaimarrornis** Hodgson, 1844.

Chaimarrornis leucocephala (Vigors), 1830.

(The White-capped Redstart.)

1830. *Phoenicura leucocephala*, Vigors, *Proc. Zool. Soc. Lond.*, p. 35. (Himalayas).

1924. *Chaimarrornis leucocephala* Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 79. [Corrected to *Chaimarrornis leucocephala* in vol. VIII, p. 621 (1930).]

No. 26415. Unsexed. (Bengal Duars. Nov.-Dec., 1938.)

Measurements (mm.) :—L.-161; W.-92; Tl.-80; Tr.-32; C.-13.

This Redstart is represented in the Indian Museum by a series of some 35 specimens from the following localities :—Kafiristan-Chitral area, Kashmir (including Gilgit), Simla Hills, Chamba (North East Punjab), Garhwal, Sikkim, Nepal, Darjeeling, the Abors country (North East Assam), and Burma. The series does not exhibit any striking geographical variation in colour except that birds from the higher altitudes (Gilgit, etc.) are somewhat paler than those from lower areas. The distribution of this bird also extends to Baluchistan and Afghanistan on the west and to the Shan States, Siam, Yunnan, Szechuan and Yangtse on the east, but specimens from these areas are not represented in the Indian Museum.

Subfamily *TURDINAE*.Genus *Copsychus* Wagler, 1827.***Copsychus saularis saularis* (Linnaeus), 1758.**

(The Indian Magpie-Robin.)

1758. *Gracula saularis*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 109. (Asia, Bengal).1924. *Copsychus saularis saularis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 113.

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26416	♂	Naksalbāri	Dec. 1	175	95	80	32	17
26417	Unsexed (probably ♂) ♀	Naksalbāri	Dec. 3	181	95	89	27	18
26418		Eastern bank of R. Tista (be- tween Sivok and Bagrā- kot).	Nov. 17	183	95	89	30	16
26419	♀	Khāribāri	Dec. 6	171	87	82	28	17

The specimens, while agreeing closely in plumage with the description of this race as given by Stuart Baker¹, are decidedly shorter in body length which is given by Stuart Baker as about 230 mm. as compared with 171-183 mm. in the present birds. Other measurements, however, agree with those given by that author. Possibly, Stuart Baker took the length from Yunnan and Chinese birds which are, as recognised by him, larger than the Indian birds of the same race.

This point is borne out by a large number of specimens of this race present in the Indian Museum from the following localities:—Travancore, Bangalore, Central India, Nepal, Simla Hills, and Burma including Mergui area, and also from Foochow in East China. Other races of this species, viz., *musicus* (from the Malay Peninsula), *ceylonensis* (from South Travancore,) and *andamanensis* (from the Andaman Islands), are also represented in the Museum, though poorly. A specimen from Sarawak (Borneo) is also present and is hardly distinguishable from the Indian race, except by its larger size.

5. Family MUSCICAPIDAE.

Genus *Siphia* Hodgson, 1837.***Siphia parva albicilla* (Pallas), 1811-1827.**

(The Eastern Red-breasted Flycatcher.)

1811-1827. *Muscicapa albicilla*, Pallas, *Zoograph. Russo-Asiat.* I, p. 462, Aves Pl. i. (Dauria).1924. *Siphia parva albicilla*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 211.¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, p. 113 (1924).

No. 26420. Unsexed (probably ♀). (Barrākhola. Nov. 23, 1938.)

Measurements (mm.):—L.-103 ; W.-63 ; Tl.-45 ; Tr.-17 ; C.-8.

Stuart Baker¹ states that the female and young of *S. parva albicilla* are not distinguishable from those of *S. parva parva*. Stanford & Ticehurst² and Whistler & Kinnear³, however, point out that *albicilla* females and young can be distinguished from those of *parva* by the presence in *albicilla* of the colder greyer brown of the upper-parts, the truer black of the upper tail-coverts and tail and by the white under-parts suffused with grey on the breast (instead of creamy white suffused with buff). A comparison of specimens of the two races available in the Indian Museum bears out these points. On these characters, our specimen would seem to be a female of *albicilla*. Stuart Baker (*loc. cit.*) states that *S. p. parva*, which, like *S. p. albicilla*, is a winter visitor to India, extends "as far East as Bihar and Singhbhum in Bengal". Since our specimen was shot outside the range of *parva* but within the normal range of *albicilla*, its reference, based on plumage characters, to the latter race is confirmed by distributional evidence. It may be added that *albicilla* is generally regarded as being confined to North-East India. Whistler & Kinnear (*loc. cit.*) have collected evidence to show that stragglers of *albicilla* may occur all along the base of the Himalayas, and also as far south as the Nallamalais Range (about 15°N. latitude) in South India.

The bird is represented in the Indian Museum by a small series of skins from the following areas:—Bangalore, Agra, East Bihar (Singhbhum and Manbhum), West Bengal (including Calcutta), Darjeeling, Assam and Upper Burma. The allied race *S. p. parva* is represented in the Museum by specimens from Bhoura (Malabar), South East Berar, the Central Provinces and Singhbhum (East Bihar) in India, and from Gulran in Afghanistan.

Genus *Muscicapula* Blyth, 1843.

Muscicapula sapphira Blyth, 1843.

(The Sapphire-headed Flycatcher.)

1843. *Muscicapula sapphira*, Blyth, *Journ. Asiat. Soc. Bengal* XII, p. 939 (*ex Tickell's MS.*).

1924. *Cyornis sapphira*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 225. [Corrected to *Muscicapula sapphira* in vol. VIII, p. 628 (1930).]

No. 26421. Unsexed (most probably ♀). (Barrākhola. Nov. 24, 1938.)

Measurements (mm.):—L.-102 ; W.-58 ; Tl.-44 ; Tr.-16 ; C.-7.

The bird appears to be represented in the Indian Museum by a single ill-preserved male specimen (No. 8870) from Ponsee(?) in the Kahyen Hills, Burma, collected by the British Yunnan Expedition in 1868.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, p. 211 (1924).

² Stanford, J. K. and Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXXIV, p. 904 (1931).

³ Whistler, H. and Kinnear, N. B., *Journ. Bombay Nat. Hist. Soc.* XXXVI, p. 81, (1932).

Genus **Culicicapa** Swinhoe, 1871.

Culicicapa ceylonensis ceylonensis (Swainson), 1820-1821.

(The Grey-headed Flycatcher.)

1820-1821. *Platyrrhynchus ceylonensis*, Swainson, *Zool. Illustr.* I, p. 13. (Ceylon).

1924. *Culicicapa ceylonensis ceylonensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 254. [Vide correction of range of distribution in vol. VIII, p. 632 (1930), under *C. c. pallidor*.]

No. 26422. ♂. (Naksalbāri. Dec. 1, 1938.)

Measurements (mm.) :—L.-116 ; W.-63 ; Tl.-58 ; Tr.-15 ; C.-8.

The bird is represented in the Indian Museum by a series of nearly 40 skins from practically all over its range, except Ceylon and Siam. Ticehurst¹ recognises the birds of the North-West Frontier Province, Kashmir, North-West Himalayas, Nepal and Sikkim as a separate race, *pallidor*, with Simla as the type-locality. This race is said to be paler and more brightly coloured than any of the other races. In the Indian Museum there are a number of well-preserved skins from Sikkim, Nepal, Dehra Dun, Murree and Garhwal which are not particularly pale, and skins from the Central Provinces are paler than them ; again, two skins from Manbhum and Singhbhum in East Bihar are as pale-brown as the birds from the Central Provinces and paler than some of the Western Himalayan specimens. It would, therefore, seem difficult to accept Ticehurst's new race *pallidor*. The eastern birds (East Bengal, etc.) would, however, appear to be darker, the brown being overlaid with slaty in the entire plumage. They cannot, however, be separated into a distinct race on the material available in the Museum.

The other two races of the Grey-headed Flycatcher, *viz.*, the "Malayan" race *meridionalis* and the "Chinese" race *orientalis* are not represented in the Indian Museum.

6. Family LANIIDAE.

Genus **Lanius** Linnaeus, 1758.

Lanius cristatus cristatus Linnaeus, 1758.

(The Brown Shrike.)

1758. *Lanius cristatus*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 93. (Bengal).

1924. *Lanius cristatus cristatus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 300.

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26423	(?)	Naksalbāri	Dec. 2	153	74	72	28	13
26424	♀	Khāribāri	Dec. 7	173	89	90	26	14

¹ Ticehurst, C. B., *Bull. Br. Ornith. Club* XLVII, p. 108 (1927).

Stuart Baker's¹ treatment of this bird, both as regards description of the plumage and distribution, is unfortunately incomplete. The coloration and other characters of the two specimens recorded here agree with the account given by this author for *L. c. cristatus*, with this difference that the present specimens show numerous dark brown wavy or crescentic transverse bars on the whole of the under surface and flanks, except the chin, throat, anterior breast and centre of abdomen. Such a condition is not mentioned by Stuart Baker. The discrepancy is explicable by the following statement of Oates² with regard to *Lanius cristatus* (part) which is synonymous with *L. cristatus cristatus* of to-day :—"Perfect adults have no bars on either the upper or lower plumage, but such unbarred birds are comparatively rare ; the majority have traces of bars on the breasts and flanks. Nestlings are profusely barred with dark brown on every portion of plumage, and the eye-band is brown. It takes two or more years (*vide infra*) for the bird to attain mature plumage" Ali & Whistler³, while recording the bird from Travancore and Cochin, observe that "the first winter plumage (barred on lower surface) is probably changed for the fully adult plumage (unbarred on lower surface)⁴ in the first spring"

The Brown Shrike is a winter visitor to India. Stuart Baker (*loc. cit.*) wrongly confines its Indian range to North India. It is also a common visitor to South India and Ceylon, its occurrence in the former region having been confirmed recently by Ali & Whistler (*loc. cit.*). Ticehurst⁵ states that these birds in adult plumage are quite common in Burma where, however, they do not breed. In the Indian Museum there is an excellent series of skins from the following localities :—Baluchistan (Mastung), Central Provinces, Madras Presidency (Shevaroy Hills), Travancore (Ponmudi), Bengal, Assam, Bhutan and Burma (South of the Irrawadi). Thus, this Shrike might be said to be found all over India (except the north-western portion) and Burma.

The other Indian races of *L. cristatus*, namely, *isabellinus*, *lucionensis* and *phoenicuroides*, are also represented in the Indian Museum.

Stuart Baker⁶ claims to have found nests of *Lanius cristatus cristatus* in the Cachar and the Khasia Hills in Assam ; the accuracy of the claim is, however, questioned by Ticehurst (*loc. cit.*).

7. Family ARTAMIDAE.

Genus **Artamus** Vieillot, 1816.

Artamus fuscus Vieillot, 1817.

(The Ashy Swallow-Shrike.)

1817. *Artamus fuscus*, Vieillot, *Nouv. Dict. d'Hist. Nat.* XVII, p. 297. (Bengal).
1924. *Artamus fuscus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 348.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, p. 300 (1924).

² Oates, E. W., *Fauna Br. India, Birds* (1st ed.) I, p. 469 (1889).

³ Ali, S. and Whistler, H., *Journ. Bombay Nat. Hist. Soc.* XXXVIII, p. 307 (1935).

⁴ Parentheses by the author.

⁵ Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXXVIII, pp. 824, 825 (1936).

⁶ Baker, E. C. Stuart, *Ibis* I (7th Ser.), p. 330 (1895); *Nidification Birds Indian Emp.* II, pp. 270, 271 (1933).

No. 26427 ♂. (Naksalbāri. Dec. 5, 1938.)

Measurements (mm.) :—L.-181 ; W.-135 ; Tl.-66 ; Tr.-18 ; C.-17.

The bird is represented in the Indian Museum by a series of about 30 skins from Travancore, Central Provinces, Orissa, Bengal (Calcutta and Darjeeling), Sikkim and Assam. It is not found in Western and North-Western India.

The only other Indian representative of Artamidae, viz., *Artamus leucorhynchos humei*, is not represented in the Indian Museum.

8. Family DICRURIDAE.

Genus **Dicrurus** Vieillot, 1817.

Dicrurus macrocercus albirictus Hodgson, 1837.

(The Himalayan Black Drongo.)

1837. *Dicrurus albirictus*, Hodgson, *Indian Rev.* I, p. 326. (Nepal).

1924. *Dicrurus macrocercus albirictus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 357.

No. 26425. ♂. (Khāribāri. Dec. 6, 1938.)

Measurements (mm.) :—L.-305 ; W.-154 ; Tl.-183 ; Tr.-27 ; Culmen (full)—22 ; Culmen from anterior edge of nostrils to tip—18 ; Width of culmen at nostrils—9.

Ticehurst¹ does not support the recognition of a special Himalayan race of the Black Drongo as has been done by Stuart Baker², and says : “ No reliance can be placed on average measurements when sex is disregarded or is unknown, as obviously one group might contain more males or more females than the other. The maximum wing length and the minimal tail length in the two supposed races (*D. m. macrocercus* and *D. m. albirictus*) are precisely the same and I cannot find on my own measurements any difference in the bill length between the two ”

I agree with Ticehurst's views. In the fairly large series of skins of the Black Drongo from all over India present in the Indian Museum no separation of the Himalayan race is possible, and any such separation would be purely arbitrary. I have assigned the bird here recorded from the Bengal Duars to *albirictus* merely because of geographical reasons and for the sake of uniformity with Stuart Baker's nomenclature. The small Ceylonese race *minor* is not represented in the Indian Museum. There are a few birds from Southern Burma, but their assignment to the various races recognised by Stuart Baker is not easy for reasons similar to those given above for his Himalayan race.

¹ Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXXI, p. 496 (1926).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, p. 357 (1924).

Genus **Chaptia** Hodgson, 1837.

Chaptia aenea aenea (Vieillot), 1817.

(The Northern Bronzed Drongo.)

1817. *Dicrurus aeneus*, Vieillot, *Nouv. Dict. d'Hist. Nat.* IX, p. 586. (Bengal, restricted to Dacca).

1924. *Chaptia aenea aenea*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) II, p. 368.

No. 26426. ♀. (Eastern bank of R. Tista, between Sivok and Bagrākot. Nov. 17, 1938.)

Measurements (mm.):—L.-224 ; W.-123 ; Tl.-128 ; Tr.-18 ; C.-19.

Notwithstanding the review of the family Dicruridae by Stuart Baker¹ and his subsequent account in the *Fauna*², the distinction between the two subspecies of *Chaptia aenea*, namely, *C. a. aenea* and *C. a. malayensis*, is based on unsatisfactory characters. Difference in size is said to be the only important distinction between the two, as the colour within the limits of each subspecies varies considerably. A brief description of the colour of the present specimen is, therefore, given below :—Colour of entire plumage black. Whole of upper plumage glossed with steel blue ; tufts of feathers at anterior end of crown and on forehead not glossed. Lores, sides of head below the eye, and ear coverts not glossed. Anterior breast black, glossed with steel blue. The rest of the lower plumage dark grey, becoming paler towards the vent. Primaries and upper tail feathers not glossed, except thinly at the outer edges.

Chaptia aenea is represented in the Indian Museum by a series of some 30 skins ranging from South India, and *via* Eastern India to Burma, Malacca and Borneo. I am quite unable to distinguish the two races *aenea* and *malayensis* from their plumage, and the little difference in average wing-length given by Stuart Baker² does not appear to be sufficiently significant. Birds from South India (Travancore, Mangalore, Shevaroy Hills, etc.), Bengal (Darjeeling and Calcutta), Assam (Garo Hills and Sylhet), Burma (South Irrawady, Arakan and Upper Burma) and Malacca appear to be all alike. Stuart Baker³ adds Sumatra and Borneo to the range of *C. a. malayensis*. It would appear, however, that while birds from India, Burma and Malaya all probably belong to a single race—I cannot support their division into two races *aenea* and *malayensis*,—the Borneo birds are probably different, as is shown by a skin (No. 22635) from Kushing (Sarawak, Borneo) in the Indian Museum. In this specimen, unlike the Indian and Malayan birds, not only the breast, but also the whole of the under-part, including the throat, abdomen and under-tail coverts, are black and are glossed. Whether Sumatran birds are similar to this Borneo bird, I am unable to say. Kuroda⁴ does not record *Chaptia aenea* from Java.

¹ Baker, E. C. Stuart, *Novitat. Zool.* XXV, pp. 291, 304 (1918).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) II, pp. 368, 369 (1924).

³ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) VIII, p. 630 (1930).

⁴ Kuroda, N., *Birds Is. Java* I (1931).

9. Family ORIOLIDAE.

Genus **Oriolus** Linnaeus, 1766.**Oriolus xanthornus xanthornus** (Linnaeus), 1758.

(The Indian Black-headed Oriole.)

1758. *Coracias xanthornus*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 108. (Bengal).1926. *Oriolus xanthornus xanthornus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) III, p. 11.

No. 26428. ♂. (Khāribāri. Dec. 6, 1938.)

Measurements (mm.):—L.-220; W.-146; Tl.-100; Tr.-35; C.-30.

Stuart Baker's¹ description of the plumage of this common bird is unsatisfactory, as pointed out by Stanford & Ticehurst² who state that Stuart Baker's description of the adult female applies in reality to the first winter bird. These authors, as also Whistler & Kinnear³, further point out that the adult female is like the adult male, except that the upper and under parts are somewhat duller and there is a black bar across both webs of the rectrices extending to the outermost or penultimate. There is a large number of birds in the Indian Museum collections labelled as "females" (presumably adult), but which should, according to the above contention of Stanford & Ticehurst, be regarded not as adults but as first winter birds. There appear to be no other "adult" females in the Indian Museum, so that it is not possible to test the accuracy of the above mentioned claims of Stanford & Ticehurst and of Whistler & Kinnear.

In the Indian Museum are also present a few birds from Ceylon and Travancore, and two from the Andaman Islands. Although Stuart Baker⁴ distinguishes a distinct Ceylonese race, I am unable to separate the "Ceylon" birds from the "Indian". Similarly, the Andaman birds are inseparable from the rest, except perhaps by their smaller size.

10. Family STURNIDAE.

Genus **Acridotheres** Vieillot, 1816.**Acridotheres tristis tristis** (Linnaeus), 1766.

(The Common Myna.)

1766. *Paradisea tristis*, Linnaeus, *Syst. Nat.* (12th ed.) I, p. 167. (Philippines, by mistake?; Calcutta).1926. *Acridotheres tristis tristis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) III, p. 53.

No. 26429. ♂. (Sivok Ghāt. Nov. 25, 1938.)

Measurements (mm.):—L.-228; W.-138; Tl.-85; Tr.-41; C.-21.

This bird is very wide-spread, being found throughout Afghanistan, India, Burma and part of Siam. It is poorly represented in the Indian

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) III, p. 11 (1926).² Stanford, J. K. and Ticehurst, C. B., *Ibis* II (14th Ser.), p. 600 (1938).³ Whistler, H. & Kinnear, N. B., *Journ. Bombay Nat. Hist. Soc.* XXXVI, p. 585 (1933).⁴ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) III, p. 12 (1926).

Museum, where skins from the following localities are present :—Chitral, Kashmir, Kumaun Hills, Nepal, Bengal, Orissa, Baroda in Central India, Jodhpur in Rajputana, Travancore and Upper Burma. There is an albino specimen (No. 25453) from Tocklai (Assam) in which the black and brown pigments have been largely suppressed and the plumage is white, lightly speckled with dark brown.

The Ceylonese race *A. t. melanosternus* is not represented in the Indian Museum.

11. Family PLOCEIDAE.

Subfamily PLOCEINAE.

Genus **Ploceus** Cuvier, 1817.

Ploceus philippinus (Linnaeus), 1766.

1766. *Loxia philippina*, Linnaeus, *Syst. Nat.* (12th ed.) I, p. 305. (Ceylon [Hartert]).

1926. *Ploceus philippinus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) III, p. 67.

No. 26430. ♀. (Naksalbāri. Dec. 1, 1938.)

Measurements (mm.) :—L.-138 ; W.-70 ; TL.-56 ; Tr.-22 ; C.-16.

The bird is represented in the Indian Museum by a small series of skins from Agra, Lucknow, Singhbhum, Calcutta, South Berar, and South Mangalore, and a few also from Nepal. Although the bird is found throughout India, other Indian localities are not represented in the Museum. Skins of the allied species, such as *megarhynchus*, *benghalensis* and *atrigula*, are also available, but the collection of Bayas and Weaver-birds in the Indian Museum is, on the whole, poor.

12. Family FRINGILLIDAE.

Subfamily FRINGILLINAE.

Genus **Passer** Brisson, 1760.

Passer domesticus indicus Jardine & Selby, 1831.

(The Indian House-Sparrow.)

1831. *Passer indicus*, Jardine & Selby, *Illustr. Indian Ornith.* III, p. 118. (Continental India. Now restricted to Karachi in Sind.)

1926. *Passer domesticus indicus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) III, p. 170.

No. 26431. ♂. (Siliguri. Nov. 15, 1938.)

Measurements (mm.) :—L.-130 ; W.-73 ; TL.-60 ; Tr.-19 ; C.-11.

The bird is poorly represented in the Indian Museum, considering that the House-Sparrow is among the most familiar birds in India. A few representatives of the other two Indian races, viz., the Burmese race *nigricollis* and the Kashmir race *parkini*, which are also present, can be distinguished from *indicus* by the chocolate on the head, neck and mantle being deeper and more extensive. A female *Passer*

domesticus (No. 9773) from Bushire (South Iran) is also present; it is much paler than the Indian birds, and I am not certain whether it can be placed under *P. d. indicus* even though this race is said to extend to Western Iran, Southern Arabia, Iraq and Transcaspia.

13. Family MOTACILLIDAE.

Genus **Motacilla** Linnaeus, 1758.

The difficulty of identifying the various subspecies of Indian Wagtails has been commented upon by most workers, notably by Ticehurst¹ and by Stuart Baker².

Motacilla alba baicalensis Swinhoe, 1871.

(Swinhoe's White Wagtail.)

1871. *Motacilla baicalensis*, Swinhoe, *Proc. Zool. Soc. Lond.*, p. 363. (? Eastern Asia).

1926. *Motacilla alba baicalensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) III, p. 260.

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26432	♀	Eastern bank of R. Tista (between Sivok and Bagrākot).	Nov. 17	169	89	88	24	14
26433	♀	Barrākhola	Nov. 24	173	90	91	24	13

The birds here recorded agree with Stuart Baker's³ description of *M. a. baicalensis*, and are distinguishable from the closely allied race *M. a. personata* by their white chin in contrast to the black of *personata*. In bird No. 26432 the white chin is mottled with black so that this specimen appears to be an intermediate (a hybrid ?) between *personata* and *baicalensis*. A few such intermediates are also present in the collections of the Indian Museum.

M. a. baicalensis breeds in Eastern Siberia from Lake Baikal to East Manchuko (Manchuria), and winters in South China, Yunnan, Burma and India. The most western Indian range is given by Stuart Baker (*loc. cit.*) as North Cachar in Assam. In the Indian Museum there are a number of well-preserved skins of *baicalensis* from as far west as Kashgar, Gilgit and Ladak, and also from Simla and Sikkim. The range of this bird must, therefore, be extended west up to Kashgar in Eastern Turkestan.

On the other hand, *M. a. personata* breeds from Turkestan to South-West of Lake Baikal, Afghanistan, and perhaps also in Kashmir and the North-West Frontier of India. It visits "Gilgit, Kashmir, Ladak

¹ Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXVIII, pp. 1082-1090 (1922).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) III, pp. 260-275 (1926).

³ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) III, p. 260 (1926).

and the extreme North-West Frontier of India" For the following reasons, this range needs drastic extension eastwards so as to cover practically the whole of the North Indian Plains and reach up to Burma :—(i) Stevens¹ records this race (*personata*) from the north-eastern portion of Upper Assam, referring to two specimens, one caught in September 1904, and adding : " the only records " This record was overlooked by Stuart Baker². (ii) Wickham³ records both *personata* and *baicalensis* from the Shan States in Burma. (iii) A second Burmese record of *personata* is that of Stanford & Ticehurst⁴ from Manpwa on the Irrawady in February, the year of record not being given. (iv) From the above records one would expect that *personata* should also be found in the zone lying between the North-Western Frontier and Burma. This expectation is partially fulfilled by an examination of the collections in the Indian Museum in which there is a skin of *personata* from the Punjab, a second from Agra in the United Provinces, and a third from Nagpur in the Central Provinces. It may confidently be predicted that *personata* will be found throughout the North Indian Plains.

On the basis of the above remarks, the distribution of the two races may be summarised as follows :—

Motacilla alba baicalensis.—Breeding in East Siberia, from Lake Baikal to East Manchuko (Manchuria). Wintering in South China and via Yunnan, Burma, Assam, Sikkim and Simla to Gilgit, Ladak and Kashgar, apparently being confined to the hilly tracts and not spreading south to the Indian Plains whence no records have so far been obtained.

Motacilla alba personata.—Breeding from Turkestan to South-West of Lake Baikal, in Afghanistan, and perhaps also in Kashmir and in the ranges of the North-West Frontier of India. Wintering in India, entering via Kashgar, Ladak, Kashmir, North-West Frontier Province, the Punjab and the United Provinces, and spreading east to Assam and Burma ; its southern limit in India is Nagpur in the Central Provinces.

We thus have an interesting example of two races of a species breeding in different but adjoining areas in the North and wintering in a more or less common country in the South. *Motacilla alba baicalensis* breeds in Siberia, East of Lake Baikal, and migrates south in winter, entering India by the North-Eastern Passage and reaching up to and even a little beyond the North-Western portion of the country. *M. a. personata*, on the other hand, breeds in Central Asia, South-West of Lake Baikal up to the North-Western Frontier of India, and is a winter migrant into India, entering it by the North-Western Passage, spreading itself throughout the North-Indian Plains and reaching east up to Burma. As stated above, it would appear from available records that the winter distribution of the two races in India is probably mutually exclusive, at any rate partly. Thus, *baicalensis* confines itself to the cooler foot-hills of the Himalayas, not spreading south to the warmer plains ; *personata*, on the other hand, is found not only in the cooler

¹ Stevens, H., *Journ. Bombay Nat. Hist. Soc.* XXIII, p. 266 (1914).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) III, pp. 259, 260 (1926).

³ Wickham, P. F., *Journ. Bombay Nat. Hist. Soc.* XXXIV, p. 50 (1930).

⁴ Stanford, J. K. and Ticehurst, C. B., *Ibis* V (13th Ser.), pp. 267, 268 (1935).

regions of Kashmir, Gilgit, etc., but also spreads to the warmer plains further south.

Collections of these Wagtails, both in the North Indian Plains and in Assam and Burma, are greatly to be desired for a fuller determination of their winter distribution.

Motacilla maderaspatensis Gmelin, 1789.

(The Large Pied Wagtail.)

1789. *Motacilla maderaspatensis*, Gmelin, *Syst. Nat.* I, p. 961. (India).

1926. *Motacilla lugubris maderaspatensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) III, p. 263. [In vol. VIII, p. 659 (1930), Stuart Baker remarks that owing to the uncertainty of the status of *M. l. maderaspatensis* and allied subspecies, they should for the present be raised to specific rank. Accordingly, *M. lugubris maderaspatensis* becomes *M. maderaspatensis*.]

No. 26434. ♂. (Mongpong. Nov. 18, 1938.)

Measurements (mm.) :—L.-195 ; W 97 ; TL.-105 ; Tr.-27 ; C.-15.

The present specimen differs from Stuart Baker's¹ description of the species in two points : (i) It is much shorter in body length which is only 195 mm. as compared with 240 mm. given by Stuart Baker. Specimens in the Indian Museum from practically the whole of the Indian range of the species measure 185 to 220 mm. in length. (ii) Its outer tail feathers are white edged with black on the inner web, instead of being black edged with white as described by Stuart Baker. The specimens in the Indian Museum conform to the present, rather than to Stuart Baker's, description.

Regarding its range, Stuart Baker includes West Bengal but categorically excludes East Bengal. The present find from North-East Bengal would, therefore, extend the range of the species to Eastern Bengal.

(B) Order CORACIIFORMES.

(a) Suborder *PICI*.

14. Family *PICIDAE*.

Subfamily *PICINAE*.

Genus **Dryobates** Boie, 1826.

Dryobates macei (Vieillot), 1818.

(The Fulvous-breasted Pied Woodpecker.)

1818. *Picus macei*, Vieillot, *Nouv. Dict. d'Hist. Nat.* XXVI, p. 80. (Bengal).

1927. *Dryobates macei*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) IV, p. 39.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) III, p. 263 (1926).

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26435	♂	Naksalbāri	Dec. 3	180	107	70	20	24
26436	♀	Naksalbāri	Dec. 3	170	100	72	20	20

The status of this species is uncertain, and Stanford & Ticehurst¹ regard it as a subspecies of *D. atratus*.

Stuart Baker² gives the most eastern range of *D. macei* as Akyab in South-Western Burma. He, however, overlooked the work of Oates³ who recorded it (*Picus macii*) from Bhamo in Northern Burma. Very recently, Stanford & Ticehurst (*loc. cit.*) have recorded it from several parts of Burma, viz., from the Hukwang, Irrawady and Namyin Valleys, from Hakmati Long Plain and from the lower hills near Tingpai. It is well known that *D. atratus* occurs practically throughout Burma. On rather slender evidence, Stanford & Ticehurst (*loc. cit.*) conclude that the distributions of *macei* and *atratus* in Burma are mutually exclusive. There can be no question that our knowledge of their distribution in Assam and Burma is in a state of confusion and I agree with Stanford & Ticehurst in their remark that the distribution of both the species needs more attention in these areas.

The western limit of *macei* given by Stuart Baker⁴ as Murree also does not appear to be correct, for Ticehurst⁵ observes : " This species certainly does not extend as far west as Murree (specimens, Whistler Coll.) but the western race is easily separable by the longer bill and wing from the Bengal race. ♂♂. W.(ing) 114-118. B.(ill) 26-30. The western form is *Dryobates macei westermanni* Blyth. (*Ibis* 1870, p. 163). Type in Amsterdam Museum " Stuart Baker⁶, however, says that on the material available he is unable to distinguish *westermanni* from the typical form.

There is a small collection of these birds in the Indian Museum from the following localities :—Nepal ; Nadia and Darjeeling Districts and Calcutta in Bengal ; Daffa Hills (South Bhutan and North Assam) ; Garo Hills (Western Assam) ; and Rotung (1,400 ft.) and Kobo (400 ft.) towards North-Eastern Assam. The birds from the last two places were collected by the British Abors (North-Eastern Assam) Expedition.

¹ Stanford, J. K. and Ticehurst, C. B., *Ibis* III (14th Ser.), pp. 4, 5 (1939).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) IV, p. 40 (1927).

³ Oates, E. W., *Ibis* VI (5th Ser.), p. 72 (1888).

⁴ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) IV, p. 40 (1927).

⁵ Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXXIV, pp. 468, 469 (1930).

⁶ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) VIII, p. 671 (1931).

15. Family CAPITONIDAE.

Genus **Thereiceryx** Blanford, 1893.**Thereiceryx lineatus hodgsoni** (Bonaparte), 1850.

(The Assam Lineated Barbet.)

1850. *Megalaema hodgsoni*, Bonaparte, *Cospect. Gener. Avium* I, p. 144. (Bengal).1927. *Thereiceryx lineatus hodgsoni*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) IV, p. 111.

No. 26437. ♀. (Gish. Nov. 21, 1938.)

Measurements (mm.):—L.-240 ; W.-131 ; Tl.-95 ; Tr.-35 ; C.-34.

Stuart Baker¹ separates the Assam race *hodgsoni* from the Burmese race *intermedius* merely on the ground of slight difference in average wing length. Ticehurst² objects to this and points out that the Burmese race is unrecognisable. An examination of the excellent series of skins in the Indian Museum from the South Irrawady (Burma) seems to support Ticehurst's conclusion.

Genus **Cyanops** Bonaparte, 1854.**Cyanops asiatica asiatica** (Latham), 1790.

(The Blue-throated Barbet.)

1790. *Trogon asiaticus*, Latham, *Index Ornith.* I, p. 201. (India. Now restricted to Calcutta.)1927. *Cyanops asiatica asiatica*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) IV, p. 116.

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26438	♀	Naksalbāri	Dec. 3	205	100	68	30	25
26439	♀	Naksalbāri	Dec. 6	200	101	71	28	22

It is clearly recognised by Blanford³, by Stuart Baker⁴ and by Whistler⁵ that one of the distinctions between the present bird and the closely allied subspecies *C. a. davisoni* is that whereas in *asiatica* the band across the vertex is black, in *davisoni* it is blue. In a later work, however, Stuart Baker⁶ gives the correction that for *asiatica* the "black" band across the vertex should read "blue". This correction appears to be doubtful. It may be added that Stuart Baker's

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) IV, p. 111 (1927).² Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXXIV, p. 470 (1930).³ Blanford, W. T., *Fauna Br. India, Birds* (1st ed.) III, pp. 92-94 (1895).⁴ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) IV, p. 116 (1927).⁵ Whistler, H., *Pop. Handb. Indian Birds*, p. 224 (1928).⁶ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) VIII, p. 675 (1930).

(1927, *op. cit.*, vol. IV, p. 118) description of *C. a. davisoni* as having the band across the vertex "black instead of blue" also appears to be incorrect, and should be "blue instead of black". In short, the band across the vertex is black in the subspecies *asiatica* and blue in *davisoni*. The large series of skins of *C. a. asiatica* and a smaller one of *C. a. davisoni* present in the Indian Museum confirm this point.

Genus **Xantholaema** Bonaparte, 1854.

Xantholaema haemacephala indica (Latham), 1790.

(The Burmese Crimson-breasted Barbet.)

1790. *Bucco indicus*, Latham, *Index Ornith.* I, p. 205. (Calcutta).

1927. *Xantholaema haemacephala indica*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) IV, p. 127.

No. 26440. ♂. (Khāribāri. Dec. 5, 1938.)

Measurements (mm.) :—L.-144 ; W.-84 ; Tl.-40 ; Tr.-25 ; C.-17.

Stuart Baker¹ distinguishes two races of *Xantholaema haemacephala* in India, viz., the "Burmese" race *X. h. indica* and the "Indian" race *X. h. lutea*. Whistler & Kinnear², however, point out that this distinction is untenable as specimens from India, Ceylon and Burma cannot be distinguished from one another, and all belong to a single race.

An examination of the excellent series of skins from all over India (excluding the North-Western and Western portions, i.e., the Punjab, Sind, Gujrat, etc.), Ceylon, Burma, and the Malay Peninsula present in the Indian Museum, confirms Whistler's contention, and I am unable to distinguish the two races of Stuart Baker. There is an albino specimen (No. 5031) collected in 1869 from the Midnapur jungles, Bengal. In this bird the entire plumage is white, with the exception of the seventh to tenth primaries and four of the following secondaries which are dusky, narrowly edged on the outer webs with grey-green; the areas of the fore-crown and fore-breast, which are bright crimson in the normal bird, are light golden in the albino specimen; the bill and legs are also devoid of black pigment and are pale horny brown.

(b) Suborder *CORACII*.

16. Family CORACIIDAE.

Genus **Coracias** Linnaeus, 1758.

Coracias benghalensis benghalensis Linnaeus, 1758.

(The Indian Roller or Blue Jay.)

1758. *Coracias benghalensis*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 106. (Bengal)

1927. *Coracias benghalensis benghalensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) IV, p. 224.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) IV, pp. 126-129 (1927).

² Whistler, H. and Kinnear, N. B. *Journ. Bombay Nat. Hist. Soc.* XXXVII, pp. 516, 517 (1934).

No.	Sex.	Locality.	Date (1938).	Measurements (mm.).				
				L.	W.	Tl.	Tr.	C.
26441	(?)	Siliguri	Nov. 26	305	150	128	27	30
26442	♂	Naksalbāri	Dec. 3	325	185	140	33	33

This bird is poorly represented in the collections of the Indian Museum ; there are only about two dozen specimens from the following localities :—Chanda in the Central Provinces ; Ahmadabad in Gujrat ; Purnea and Singhbhum in Bihar ; and Nadia District and Calcutta in Bengal. In many of these specimens, *viz.*, from Chanda, Ahmadabad, Calcutta and Singhbhum, the nuchal collar is reddish purple and is well-marked. There is also a specimen from Khist (Southern Iran) which seems to belong to this race. Specimens from Rajputana, Sind and the Punjab are wanting.

The Southern Indian race *C. b. indica* is represented in the Indian Museum by a few skins from Travancore, while of the "Burmese" race *C. b. affinis* there is a single specimen from the Amingaon District in Assam.

(c) Suborder *STRIGES*.

17. Family *ASIONIDAE*.

Subfamily *BUBONINAE*.

Genus *Athene* Boie, 1822.

Athene brama indica (Franklin), 1831.

(The Northern Spotted Owl.)

1831. *Noctua indica*, Franklin, *Proc. Zool. Soc. Lond.*, p. 115. (United Provinces).

1927. *Athene brama indica*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) IV, p. 440.

No. 26443. ♂. (Siliguri. Nov. 26, 1938.)

Measurements (mm.) :—L.-213 ; W.-170 ; Tl.-95 ; Tr.-37 ; C.-19.

The bird here recorded would, because of its larger size, appear to belong to the race *indica* rather than to the Burmese race *pulchra*, although the colour is slaty-brown and much darker than is usual for *indica*. In the Indian Museum collections there are several specimens from Upper Burma which by their small size may be said to belong to *pulchra* ; in coloration, however, while many are dark like true *pulchra*, one specimen is paler like the true *indica*. It would, therefore, seem that forms intermediate between *pulchra* and *indica* are found from North-East Bengal to Upper Burma, although *indica* predominates east up to Assam, while *pulchra* predominates in Upper Bengal to Upper Burma and ultimately completely replaces *indica* in

Central and South Burma and extends further east up to Yunnan and Cambodia.

A. b. indica is represented in the Indian Museum by a fine series of skins from Bihar, Bengal, Assam (Cachar and Gauhaty), the Agra District and Ahmadabad; there is a specimen from Bampur (Baluchistan) which seems to belong to this race, and another from Upper Burma. Stuart Baker¹ gives the western limit of the race as Sind. In view of the above specimen from Baluchistan, the range should be extended further west to include that area. There is an albino bird from Benares in which the entire plumage is pure white.

The Burmese race *A. b. pulchra* is represented in the Indian Museum by a few specimens from Upper and Western Burma, the Southern Irrawady and Mandalay. Of the South Indian race, *A. b. brama*, there are only four specimens from the East Mangalore District, the Shevaroy Hills, the Bangalore District and Trivandrum.

(C) Order ACCIPITRES.

18. Family FALCONIDAE.

Subfamily FALCONINAE.

Genus **Cerchneis** Boie, 1826.

Cerchneis tinnunculus tinnunculus (Linnaeus), 1758.

(The European or Common Kestrel.)

1758. *Falco tinnunculus*, Linnaeus, *Syst. Nat.* (10th ed.) I, p. 90. (Sweden).

1928. *Cerchneis tinnunculus tinnunculus*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) V, p. 61.

1936. *Cerchneis tinnunculus tinnunculus*, Swann, *Monogr. Birds of Prey*, Pt. XIV, p. 433.

No. 26444. ♀. (Khāribāri. Dec. 7, 1938.)

Measurements (mm.):—L.-315; W.-238; Tl.-165; Tr.-45; C.-18; Mid-toe without claw—27.

This Kestrel is a winter visitor to India from Europe. Although common up to the United Provinces, it is less common further east. Stuart Baker² observes that the bird extends "East to Yunnan and Burma, though a great number of species attributed to this form from the latter place are really *interstinctus* or *japonicus*" More recently Swann³ remarks that the eastern limit of this race remains to be worked out. The bird here recorded is very pale rufous in colour and, for this reason, I regard it as belonging to the subspecies *tinnunculus* rather than to either *interstinctus* or *japonicus*. It must, however, be pointed out that the division of this species into various races is most unsatisfactory. An examination of the large series of skins of this species in the Indian Museum from Europe, Iran, Central Asia, the whole of India

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) IV, p. 440 (1927).

² Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) V, p. 62 (1928).

³ Swann, H. Kirke, *Monogr. Birds of Prey*, Pt. XIV, p. 436 (1936).

and Burma, and finally, one skin from Foochow in East China shows that it is often quite impossible to separate, on the basis of coloration, the several races recognised by Stuart Baker and to depend merely on geographical distribution for the purpose would admittedly be undesirable. A thorough revision of the species is greatly needed.

(D) Order COLUMBAE.

19. Family COLUMBIDAE.

Subfamily COLUMBINAE.

Genus **Streptopelia** Bonaparte, 1854.

Streptopelia chinensis suratensis (Gmelin), 1789.

(The Indian Spotted Dove.)

1789. *Columba suratensis*, Gmelin, *Syst. Nat.* I, p. 778. (Surat).

1928. *Streptopelia chinensis suratensis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) V, p. 242.

No. 26445. Unsexed. (Gish. Nov. 22, 1938.)

Measurements (mm.):—L.-262 ; W.-137 ; Tl.-142 ; Tr.-25 ; C.-16.

The bird here recorded appears to be intermediate between the races *suratensis* and *tigrina*. Such intermediates are common in Cachar and Manipur, but their occurrence as far west as the Jalpaiguri District (North Bengal) is noteworthy. In the Indian Museum there are several skins from Darjeeling and Sylhet which also are intermediate between *suratensis* and *tigrina*. Stuart Baker¹ gives the distribution of *S. c. suratensis* as the whole of India, and adds that it occurs in Sind in the wet season. Ticehurst², however, points out that he searched in vain for any record of this bird from Sind ; it does not appear to occur in Sind or in South-West Punjab.

The race *suratensis* is well represented in the Indian Museum collections from the following localities :—Travancore and the rest of South India ; Berar ; Mt. Abu (Rajputana) ; Ahmadabad ; Chota Nagpur ; Singhbhum in Bihar ; Calcutta, Nadia, Midnapur and Darjeeling in Bengal ; Nepal ; and finally, Kashmir and Gilgit. The race *tigrina* is equally well represented from Assam, Burma (including Mergui and Tenasserim), Malacca, and the Malay Peninsula. There is a bird (No. 9080) from Momien (Yunnan, West China) which I am unable to distinguish from *tigrina*. Rothschild³, however, recognises and separates as race *forresti* the Yunnan birds, with the type-locality Tengueh (Yunnan), and this is accepted by Stuart Baker⁴. The fourth race *ceylonensis* is not represented in the Indian Museum.

¹ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) V, p. 242 (1928).

² Ticehurst, C. B., *Journ. Bombay Nat. Hist. Soc.* XXXIV, p. 479 (1930).

³ Rothschild, Lord, *Novitat. Zool.* XXXII, p. 293 (1926).

⁴ Baker, E. C. Stuart, *Fauna Br. India, Birds* (2nd ed.) V, p. 244 (1928).

(E) Order CHARADRIIFORMES.

Suborder LIMICOLAE.

20. Family CHARADRIIDAE.

Subfamily VANELLINAE.

Genus **Hoplopterus** Bonaparte, 1831.

Hoplopterus duvaucelli (Lesson), 1826.

(The Spur-winged Plover.)

1826. *Charadrius duvaucelli*, Lesson, *Dict. Sci. Nat.* XLII, p. 36. (Calcutta).

1929. *Hoplopterus ventralis*, Stuart Baker, *Fauna Br. India, Birds* (2nd ed.) VI, p. 184. [Corrected to *H. duvaucelli* in vol. VIII, p. 696 (1930).]

No. 26446. ♂. (Mongpong. Nov. 18, 1938.)

Measurements (mm.) :—L.-277 ; W.-198 ; Tl.-103 ; Tr.-66 ; C.-29.

The wing-spur in the specimen recorded here is well developed on the right wing, but is reduced to a nodule on the left one.

This species is very poorly represented in the Indian Museum, and there are only nine specimens from North Chanda (Central Provinces), Darjeeling Terai, and Upper and Lower Burma.

THE BLOOD-VASCULAR SYSTEM OF THE EARTHWORM *LAMPITO MAURITII* (KINB.).

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INTRODUCTION.

Students of Indian Zoology are greatly indebted to Dr. K. N. Bahl for his valuable contributions on the anatomy and development of *Pheretima*. *Pheretima*, however, is a type studied in the North Indian Universities, and also in Calcutta and Bombay ; and students of Zoology in South India have long felt the need for a complete and accurate account of the anatomy of *Lampito mauritii* (Kinb.) which is the type studied by them. To meet this long felt want, a complete study of the anatomy of *Lampito mauritii* was undertaken at the suggestion of Mr. R. V Seshaiya.

The present account deals with the blood-vascular system, and it is hoped that accounts of the other systems will be published in due course.

My best thanks are due to Dr. K. N. Bahl who was kind enough to go through the manuscript and make very helpful criticisms and suggestions, and to Mr. R. V Seshaiya for guidance and valuable suggestions. I am also thankful to Dr. S. G. Manavalaramanujam, Professor of Zoology, Presidency College, Madras, for the interest he took in my work and for sending me some of the references.

PREVIOUS WORK.

In a recent paper on the circulation of *Octochaetus thomasi*, Bleakly (1935) has given a good summary of previous work on the blood-vascular system and circulation in Earthworms. The works of Bourne (1891) on *Megascolex coeruleus*, Johnstone and Johnstone (1902) on *Lumbricus* (summarised by Bleakly), Bahl (1921) on *Pheretima*, Bleakly (1935) on *Octochaetus*, and Stephenson (1930) on Oligochaeta in general have been very useful to me in connection with my investigations. Besides giving as far as possible an adequate account of the blood system in *Lampito mauritii*, I have enumerated the differences in the blood-vascular system between *Lampito mauritii* and the genera above mentioned.

METHODS.

The methods given by Bahl (1921) were adopted for the study of the blood-vascular system. Dissections of the animal were made from the dorsal, ventral and lateral surfaces in physiological salt solution, and the blood-vessels were traced with great care under a dissecting binocular microscope. As even the major blood vessels are minute, injection with coloured fluid could not be carried out. Dissections were supplemented with a study of the transverse sections through the different regions of the body.

To study the disposition of the plexuses in the wall of the gut, the narcotised animal was first fixed in Bouin, and then opened under water,

The alimentary canal was slit open and the contents removed by a thorough washing. Small portions of the gut-wall were then removed and washed in very dilute KOH, dehydrated, and mounted as suggested by Bahl (1921).

To ascertain the course of circulation, very small worms were selected, and examined alive under a dissecting binocular microscope. The course of circulation was visible through the delicate body-wall in the case of the pulsating vessels *viz.*, the dorsal vessel and the hearts. The observations recorded show that the flow in the dorsal vessel is from behind forwards, and in the hearts from the dorsal to the ventral vessel.

The flow in the non-pulsating vessels was studied by the method described below. Live worms were cut open and pinned to a board. While viewing through the binocular dissecting microscope, the ventral vessel was cut behind the hearts. Profuse bleeding was seen from the cut end which was towards the region of the hearts. This shows the great pressure on this side, and explains also, that the flow of blood in the ventral vessel is backwards behind the hearts. By cutting the ventral vessel immediately in front of the hearts it was seen that the flow was forwards in this region. Similarly, when the ventro-tegmentaries and ventro-intestinals were cut, the flow was observed to be from their proximal ends, thereby showing, that blood flows through them from the ventral vessel. When the dorso-tegmentary vessels are cut, the flow is from the distal end, which indicates that blood flows through these vessels from the integument into the dorsal vessel. In the case of the dorso-intestinals, this method could not be adopted owing to their very small size ; they were studied only in transverse sections.

Description of the blood-vessels.

As in the case of all earthworms, in *Lampito mauritii* there is considerable difference between the blood-vessels of the anterior region and those of the intestinal region. Behind segment XIII, the arrangement of the blood-vessels is simple, typical and uniform in all segments. But in the anterior segments, where all the important organs of the animal lie, the arrangement is different. The account of the vascular system may be dealt with under three heads :—

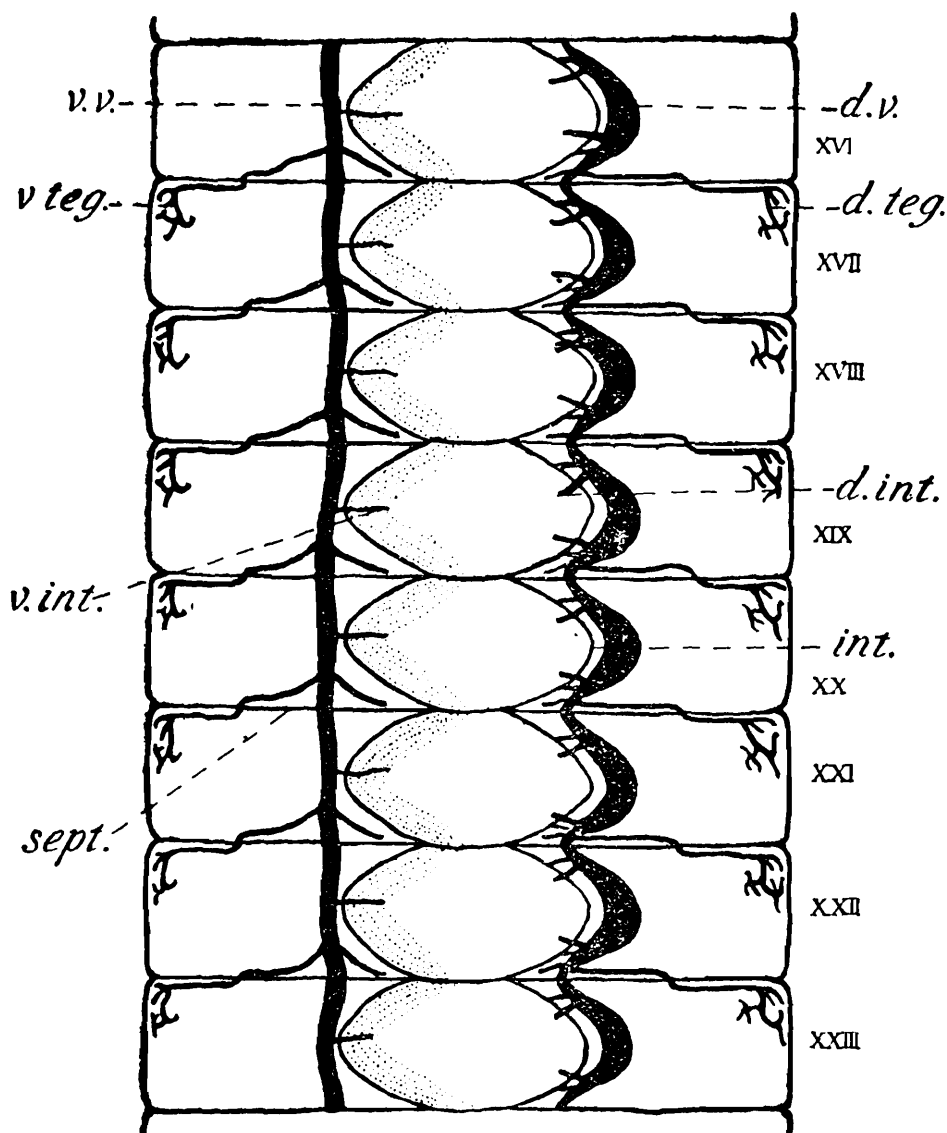
- (A) The blood-vessels behind segment XIII.
- (B) The blood-vessels of the anterior region.
- (C) The course of circulation of the blood.

A. The blood-vessels behind segment XIII—the typical arrangement.

The blood-vessels in this region some of which are not exclusively confined to this region include the following :—(1) the dorsal vessel (2) the dorso-tegmentaries (3) the dorso-intestinals (4) the ventral vessel (5) the ventro-tegmentaries (6) the ventro-intestinals (7) the intestinal plexus and (8) the parietal vessels. Of these, the dorsal vessel, the ventral vessel, and the parietal vessels extend into the anterior region also and are therefore not exclusively characteristic of this region. There are no sub-neural and sub-intestinal vessels in *Lampito mauritii*.

(1) *The Dorsal vessel.*—The dorsal vessel, as its name indicates, lies dorsal to the gut, and extends from one end of the animal to the other.

It is the central contractile vessel from which blood is sent to the different parts of the body through vessels having direct communication with it.



TEXT FIG. 1. Lateral view of eight segments (XVI to XXIII) of the intestine presenting the arrangement of the blood vessels of that region.

d.int. dorso-intestinals; *d.teg.* dorso-tegmentary; *d.v.* dorsal vessel; *int.* intestine; *sept.* septum; *v.int.* ventro-intestinal; *v.teg.* ventro-tegmentary. *v.v.* ventral vessel.

It passes through the successive intersegmental septa all along its course. Between every two successive septa, *i.e.*, in the segmental region, it is swollen, but in the passage through the septa it is very much narrowed. The structure of the dorsal vessel in the anterior region is different from that behind segment XIII and will be described later on. Behind segment XIII the dorsal vessel receives branches from the intestinal-wall and body-wall and has no hearts connected with it.

From the intestine the dorsal vessel receives in each segment two pairs of small vessels called the *dorso-intestinals*, and from the integument a pair of fine vessels in each segment called the *dorso-tegmentaries*. Posteriorly in the anal region the dorsal vessel arises from minute branches which ramify into the integument, and some of them get connected with similar minute branches of the ventral vessel.

(2) *The Dorso-tegmentaries*.—There is a pair of these in each segment arising from the body-wall and joining finally the dorsal blood-

vessel. They return blood from the body-wall to the dorsal blood vessel. Each dorso-tegumentary arises by the union of minute branches from the body-wall, and runs along the posterior face of the septum to its middle part, where it pierces the septum and enters the next preceding segment. Here it runs on the anterior face of the septum and finally joins the dorsal vessel at the point of its septal constriction. At the junction of the dorso-tegumentaries with the dorsal vessel, valves are present which allow the flow of blood from the dorso-tegumentaries into the dorsal vessel but not in the opposite direction.

(3) *The Dorso-intestinals*.—These vessels serve to carry the blood from the wall of the alimentary canal to the dorsal blood vessel. Two pairs of these found in each segment join the dorsal vessel in the middle of the segment. They arise from branches in the wall of the intestine and run to the dorsal vessel into which they open. At the point of their junction with the dorsal vessel there are valves which allow the flow of blood into the dorsal vessel but not from the latter into the dorso-intestinals.

(4) *The Ventral vessel*.—This is a longitudinal vessel running from one end of the animal to the other and lying ventral to the alimentary canal from which it is suspended by the mesentery. It is of a uniform thickness throughout, except in the anteriormost region where it narrows considerably. Its structure and origin in the anterior region will be described in detail under the blood-vessels of the anterior region.

At the posterior end of the animal the ventral vessel breaks up into minute branches some of which are connected, as pointed out before, with similar branches of the dorsal vessel. In the anterior region, as will be seen later on, it receives the lateral hearts but in the intestinal region it gives off in each segment a pair of *ventro-tegumentaries* to the integument, and a single, fine vessel, the *ventro-intestinal*, to the wall of the intestine. The ventral vessel is non-contractile and has no valves.

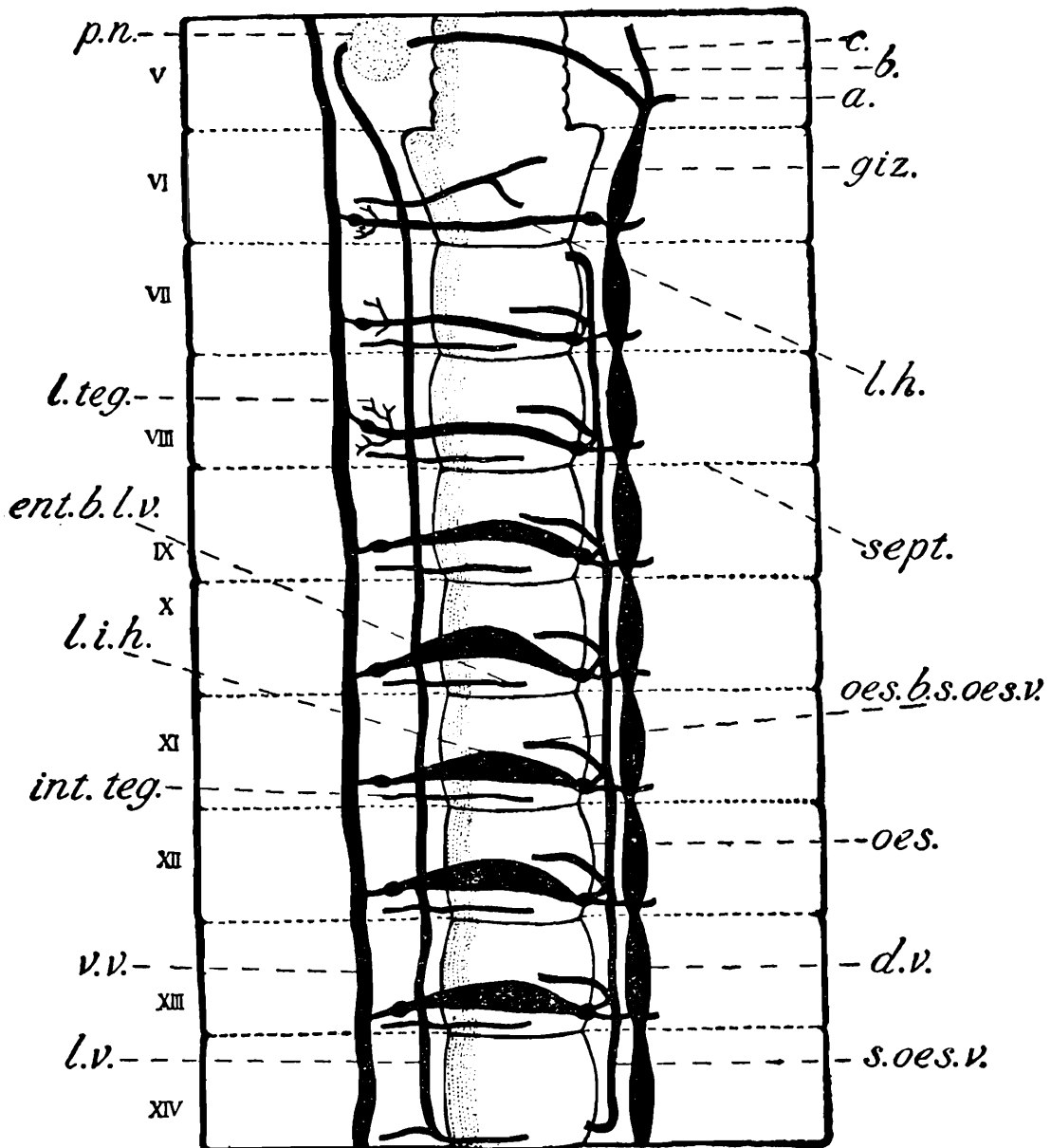
(5) *The Ventro-tegumentaries*.—These carry blood from the ventral vessel to the body-wall. They are paired vessels, arising posteriorly in each segment from the ventral vessel, and proceeding towards the middle of the posterior septum of the segment where they run on its anterior surface. Then they pass through the septum and enter the succeeding septum, where they run along its posterior face and finally end in capillaries in the body-wall. The ventro-tegumentary vessel in segment XVIII gives off a fine branch to the prostate gland.

(6) *The Ventro-intestinals*.—The ventro-intestinal is a minute, single vessel in each segment serving to carry the blood from the ventral vessel to the intestine. It arises from the ventral vessel about the middle of each segment and runs to the wall of the intestine. There are no valves in the ventro-intestinal vessel.

(7) *The Intestinal plexus*.—The intestinal plexus is situated between the epithelial and muscular layers of the gut-wall. It consists of a very fine anastomosing net-work of capillary vessels having the general appearance of a sinus running all round in the intestinal-wall.

(8) *The Parietal vessels*.—These are paired vessels lying one on either side of the alimentary canal and extending over six segments *viz.* XIII

to XVIII. They usually originate from eight minute branches in the body-wall in segments XIV to XVII and, running forwards, open into the lateral oesophageal vessels in segment XIII. In addition to the branches from the body-wall the parietal vessel of each side receives in segment XVIII a pair of fine branches from the prostate glands. In the middle of segments XV, XVI and XVII the parietal vessel of each side gives off a branch to the ventral wall of the intestine which divides into three before running up the wall of the intestine.



TEXT FIG. 2. Lateral view of *Lampito mauritii* from segments V to XIV, showing the arrangement of the blood vessels in that region.

a., b. and c. anterior branches of the dorsal vessel; d. v. dorsal vessel; ent. b. l. v. enteric branch of the lateral oesophageal vessel; giz. gizzard; int. teg. intestino-tegumentary; l. h. lateral heart; l. i. h. latero-intestinal heart; l. teg. latero-tegumentary; l. v. lateral oesophageal vessel; oes. oesophagus; oes. b. s. oes. v. oesophageal branch of the supra-oesophageal; p.n. pharyngeal nephridia; sept. septum; s.oes. v. supra-oesophageal vessel; v. v. ventral vessel.

B. The blood-vessels of the anterior region (Segments I to XIII).

The blood vessels of the anterior region include (1) the dorsal vessel (2) the hearts and the latero-tegumentaries (3) the lateral oesophageal vessels (4) the ventral vessel (5) the supra-oesophageal vessel and (6) the

oesophageal plexus. Of these, as stated already, the dorsal and ventral vessels are common to the anterior and posterior regions. We have also seen that the parietal vessels extend into segment XIII. All the remaining vessels are peculiar to the anterior region.

(1) *The Dorsal vessel*.—The main disposition of the dorsal vessel has already been described. In some of the Megascolecidae the dorsal vessel is double, but in *Lampito mauritii* it is single. From segment VII forwards it is more or less narrow, and in the region of the gizzard it divides into three branches, one median and two lateral. The median branch proceeds forwards and divides into minute branches supplying the body-wall and the tissue surrounding the buccal cavity. The lateral branches, on the other hand, become connected with ventro-laterally placed longitudinal vessels known as *lateral oesophageals* on either side through the pharyngeal nephridial tufts in segment V. The dorsal vessel is the main contracting vessel, and the flow of blood in it is from behind forwards.

The dorsal vessel in the anterior region does not receive any vessels from the body-wall or intestine, but is connected with the hearts.

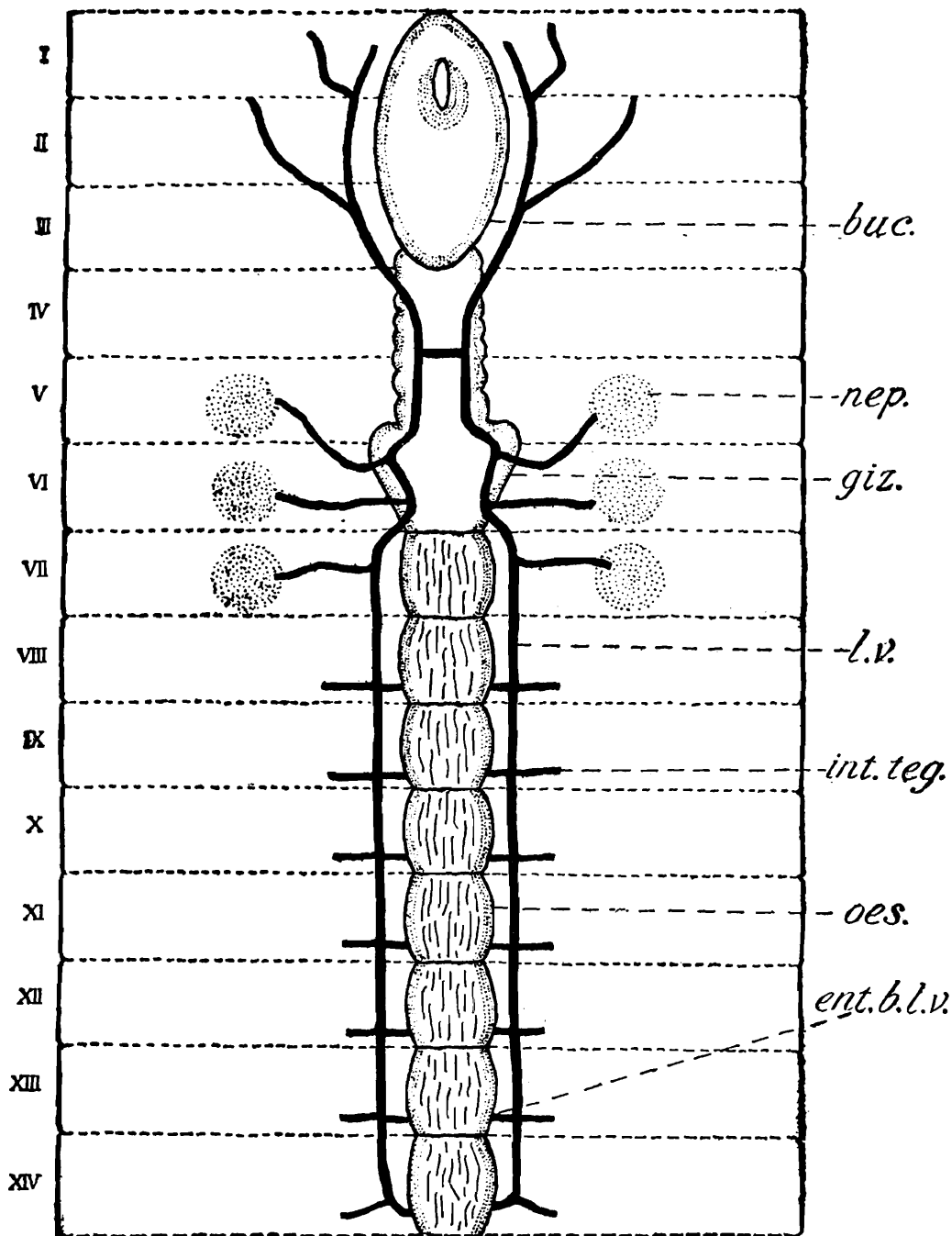
(2) *The Hearts and the Latero-tegmentaries*.—The hearts are paired contractile vessels found on the sides of the alimentary canal connecting the dorsal and the ventral vessels. There are altogether eight pairs of hearts, a pair in each of the eight segments, VI to XIII. Gates (1938) states that there are only four pairs of hearts, those in segments VI to IX being merely commissural vessels. But I have observed the contraction of all the eight pairs of vessels, and have no doubt that they are all contractile *hearts*. The anterior four pairs of hearts are thinner and longer than the posterior four pairs. The first pair of hearts encircles the gizzard. The remaining pairs arise dorsally by two roots, one from the dorsal vessel and the other from the supra-oesophageal vessel. Of the eight pairs of hearts, therefore, the first pair are the *lateral hearts* and the remaining seven pairs are the *latero-intestinal hearts*. The opening of the latero-intestinal heart into the supra-oesophageal vessel is close to that of the oesophageal vessel which runs up from the oesophageal plexus to the supra-oesophageal.

The two ends of each heart, and the dorsal connection with the dorsal vessel as well as the ventral connection with the ventral vessel are narrow. Close to either narrow end there is a bulbous dilatation of the heart.

The first three pairs of hearts, before they reach the ventral vessel close to the ventral bulbous dilatations, give off to the nephridia, the body-wall, and the spermathecae branches which may be called the *latero-tegmentaries*. These represent the *ventro-tegmentaries* of the anterior region of some authors. Since these arise from the lateral and latero-intestinal hearts and not from the ventral vessel I consider it appropriate to name them *latero-tegmentaries*. The remaining five pairs do not give off these branches.

(3) *The Lateral Oesophageal vessels*.—These are paired longitudinally disposed vessels extending from segment II to segment XIV and lying nearer the ventral side of the alimentary canal. Anteriorly they arise in the region of the buccal cavity in segment II by two minute branches on either side. In segment III each lateral oesophageal is joined by

another branch which comes from the nephridium of that segment. In segment V the two lateral-oesophageal vessels come to lie side by side on the ventral surface of the oesophagus and are connected by a transverse vessel. In segment XIV they end in a plexus on the wall of the



TEXT FIG. 3. Ventral view of *L. mauritii* from segments I to XIV, showing the disposition of the lateral oesophageal vessels and their branches.

buc. buccal region; ent. b. l. v. enteric branch of the lateral oesophageal vessel; giz. gizzard; int. teg. intestino-tegumentary; l. v. lateral oesophageal vessel; nep. nephridia; oes. oesophagus.

oesophagus. All along their course these two vessels receive branches from the body-wall and nephridia, which are called the *intestino-tegumentary* vessels of the anterior region, and give off branches to the oesophagus. The branch to the oesophagus lies in the posterior part of each segment.

Bahl (1921) has described in *Pheretima* these lateral oesophageal vessels as being the forward continuations of the sub-neural vessel which

forks at its anterior end in segment XIV. These branches are then continued forwards, soon coming to lie along the oesophagus and communicating freely with the oesophageal vessels in its wall.

Bourne (1891) adds that they are specializations of the intestino-tegumentary system. They begin anteriorly in a net-work on the pharynx with which the dorsal and ventral vessels are also connected, and end behind on the alimentary tube; they receive segmental branches from the septa, parietes and nephridia, and give off branches to the alimentary canal.

Beddard (1895) holds them to be homologous with the sub-intestinal, a double sub-intestinal, and therefore as specializations of the alimentary plexus.

In *Lampito mauritii* the sub-neural vessel is absent. The condition noticed in this species lends support to Bourne's suggestion, that the lateral oesophageals are specializations of the intestino-tegumentary system. The lateral oesophageal vessels of this form may be considered as specializations of the intestino-tegumentary system, since these two vessels are connected directly with the integument and the alimentary canal. The lateral oesophageal vessels apparently serve for the return of blood from the anterior region.

(4) *The Ventral vessel*.—It has been said already that the ventral vessel is a main non-contractile vessel running from the anterior end to the posterior end of the animal. It lies ventral to the alimentary canal, suspended from it by the mesentery, and is of a uniform thickness except in the anteriormost region where it narrows considerably. Anteriorly, in segment I the ventral vessel originates by the union of two main roots which in their turn are formed out of more minute branches. Some of the latter are connected dorsally with minute branches of the dorsal vessel.

In the region in front of segment XIV the ventral vessel gives off no branches to the integument and gut-wall. It receives however the eight pairs of hearts described already.

The flow of blood is forwards in the ventral vessel in this region.

(5) *The Supra-oesophageal vessel*.—This is a single vessel lying dorsal to the intestine and beneath the dorsal vessel, and extending from segment VII to segment XIV. It is of a uniform thickness throughout and possesses no valves. It arises in segment VII by the union of two branches coming from either side of the oesophagus. All along its course it receives a pair of branches from the oesophageal wall, running in the middle of each segment. It has already been seen that in addition to these, it is connected with the latero-intestinal hearts by a pair of branches in each of the segments VII to XIII. These two kinds of branches are connected with the supra-oesophageal close together. The oesophageal branches are afferent and take blood from the oesophagus into the supra-oesophageal, while the branches connected with the hearts are efferent and serve to carry blood into the heart from the supra-oesophageal.

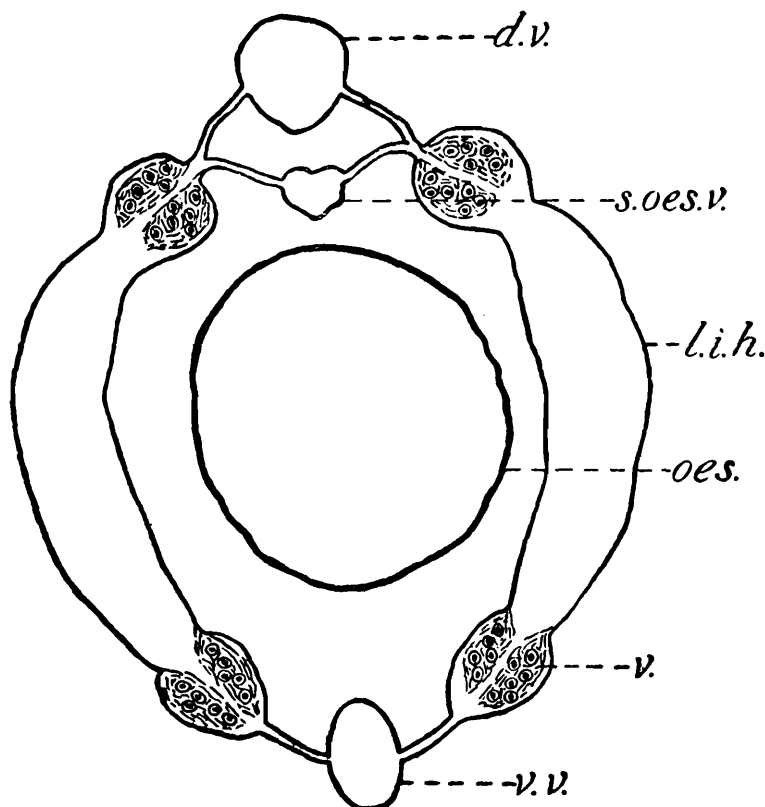
The branches from the oesophagus establish a connection between the oesophagus and the supra-oesophageal which may therefore be regarded as a specialization of the oesophageal plexus.

(6) *The Oesophageal plexus.*—This is found in the oesophageal wall between the muscular and epithelial layers extending from segments VII to XIV. It consists of a very fine and closely set net-work of capillaries, having in transverse sections of the oesophagus the appearance of a sinus running all round in the oesophageal wall. The oesophageal lining is produced into a number of finger-shaped or villi-like processes, and the oesophageal plexus extends also into these processes.

Valves.

As mentioned already, valves are present in the dorsal vessel, the lateral and latero-intestinal hearts, the dorso-intestinals, and the dorso-tegmentaries.

The valves are of two kinds (1) double-valves occurring in the hearts and (2) single circular-valves occurring in the dorsal vessel, dorso-tegmentaries, and dorso-intestinals.



TEXT FIG. 4. Transverse section passing through a pair of latero-intestinal hearts with the dorsal and ventral connections showing the valves. The layers of the body-wall are omitted.

d. v. dorsal vessel; *l. i. h.* latero-intestinal heart; *oes.* oesophagus; *s. oes. v.* supra-oesophageal vessel; *v.* valve; *v. v.* ventral vessel.

(1) *The Double-valve.*—This kind of valve occurs in the hearts. It is placed in the bulbous dilatation present near either extremity of the heart. Each valve consists of two pear-shaped masses of tissue with scattered nuclei placed opposite each other; each mass has one end attached to the wall of the heart, and the other freely projecting into the lumen of the heart. The attached end is near the dorsal vessel, while the free end is broad and directed away from the dorsal vessel. The valve at the opposite end of the heart also is similar, but its attachment is directed away from the ventral vessel and the free lobes are

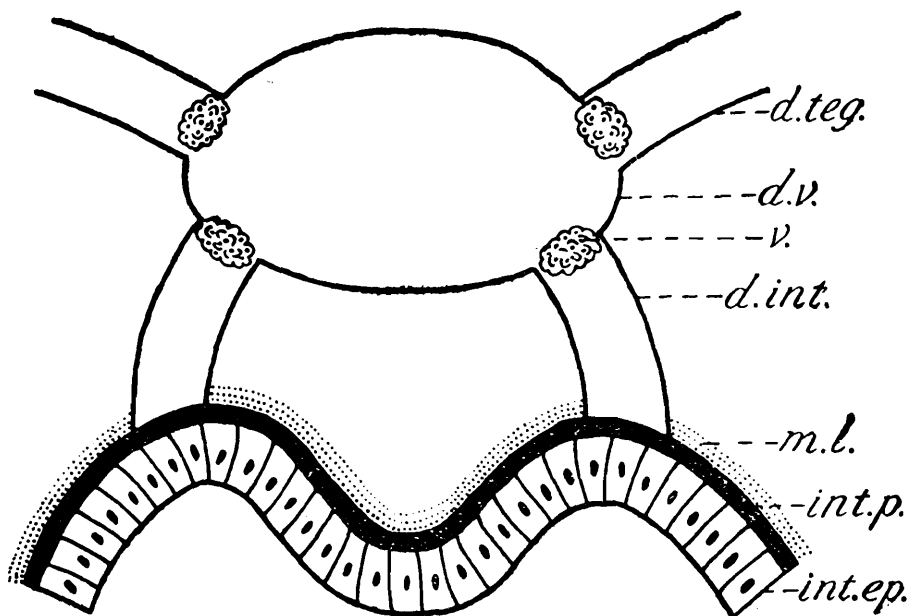
directed towards the ventral vessel. When the valves are open, they float freely in the blood stream, and when closed they meet one another and block the passage.

(2) *The Circular-valve*.—This type of valve occurs in the dorsal vessel at its septal constrictions, and at the junction of the dorso-tegmentaries and dorso-intestinals with the dorsal vessel. It consists of a mass of tissue presenting the appearance of a morula with scattered nuclei. The flap fills the entire lumen of the blood vessel at the point of its occurrence, and is attached by one end to the wall of the vessel. When the valve is open it hangs freely in the blood stream, and when closed it forms a complete transverse partition.

I was able to study the action of the valves only in the case of the hearts, the other vessels possessing valves (the dorso-tegmentaries and dorso-intestinals) being too minute for study. The flow of blood in the dorsal blood vessel, as observed in the living worm, is from behind forwards. The valves in the dorsal blood vessel allow the blood to flow only forwards. In the case of the hearts, a freshly narcotised worm was opened, and pressure applied on the heart on the side towards the dorsal vessel. Then the flow of blood down the hearts was observed. When pressure was applied on the side towards the ventral vessel there was no flow.

The course of circulation of the blood.

As in all earthworms, and as stated above, the flow of blood is forwards in the dorsal vessel, downwards in the hearts, and backwards in the ventral vessel behind the region of the hearts. Since the circulation



TEXT FIG. 5. Transverse section showing the dorsal vessel, dorso-intestinal vessel, dorso-tegmentary vessel, and the intestinal plexus. The valves present in the dorso-intestinal and dorso-tegmentary are also shown.

d. int. dorso-intestinal; *d. teg.* dorso-tegmentary; *d. v.* dorsal vessel; *int. ep.* intestinal epithelium; *int. p.* intestinal plexus; *m. l.* muscular layer; *v.* valve.

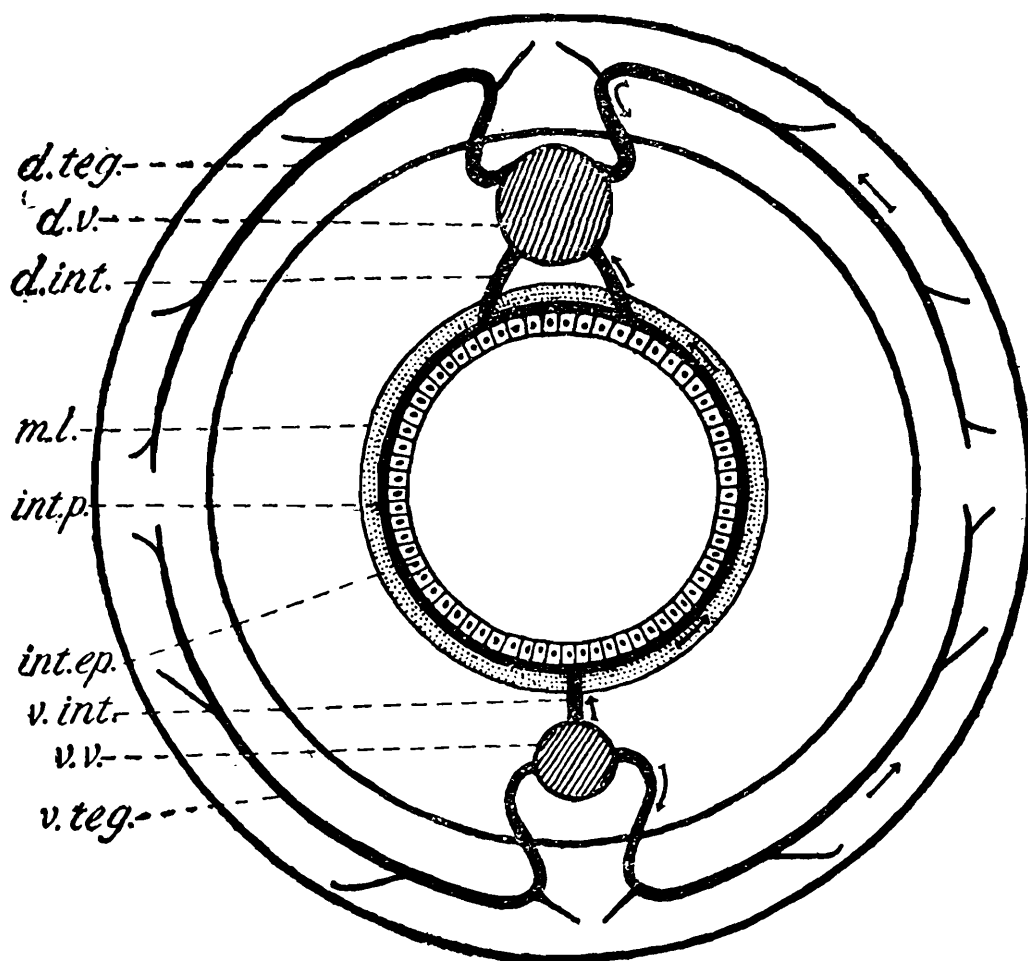
in the anterior region is different from that in the region behind, it will be convenient to deal with these two regions separately. The circulation through the parietal vessels also is dealt with separately.

1. *Circulation in the Intestinal region*.—As described already, the dorso-tegmentaries, the dorsal vessel, the dorso-intestinals, the ventral vessel, the ventro-tegmentaries, and the ventro-intestinals are the main blood vessels in this region. The course of circulation in this region was studied in the following way :—

When the dorso-tegmentary vessels are cut profuse bleeding is observed from the distal end of the cut. This shows clearly that the flow of blood in these vessels is towards and into the dorsal vessel. Moreover transverse sections show that valves are present in these vessels just at the point of their union with the dorsal vessel. These valves are disposed in such a way, that they allow blood to flow only from the dorso-tegmentaries into the dorsal vessel, but not *vice versa*.

In the dorso-intestinals, which were studied only by sections, the valves appear to allow the blood to flow into the dorsal vessel, and not from it.

Thus in the intestinal region the dorsal vessel receives blood from all the vessels connected with it.



TEXT FIG. 6. A diagrammatic sketch showing the course of circulation in the intestinal region.

d. int. dorso-intestinal; *d. teg.* dorso-tegmentary; *d. v.* dorsal vessel; *int. ep.* intestinal epithelium; *int. p.* intestinal plexus; *m. l.* muscular layer; *v. int.* ventro-intestinal; *v. teg.* ventro-tegmentary; *v. v.* ventral vessel.

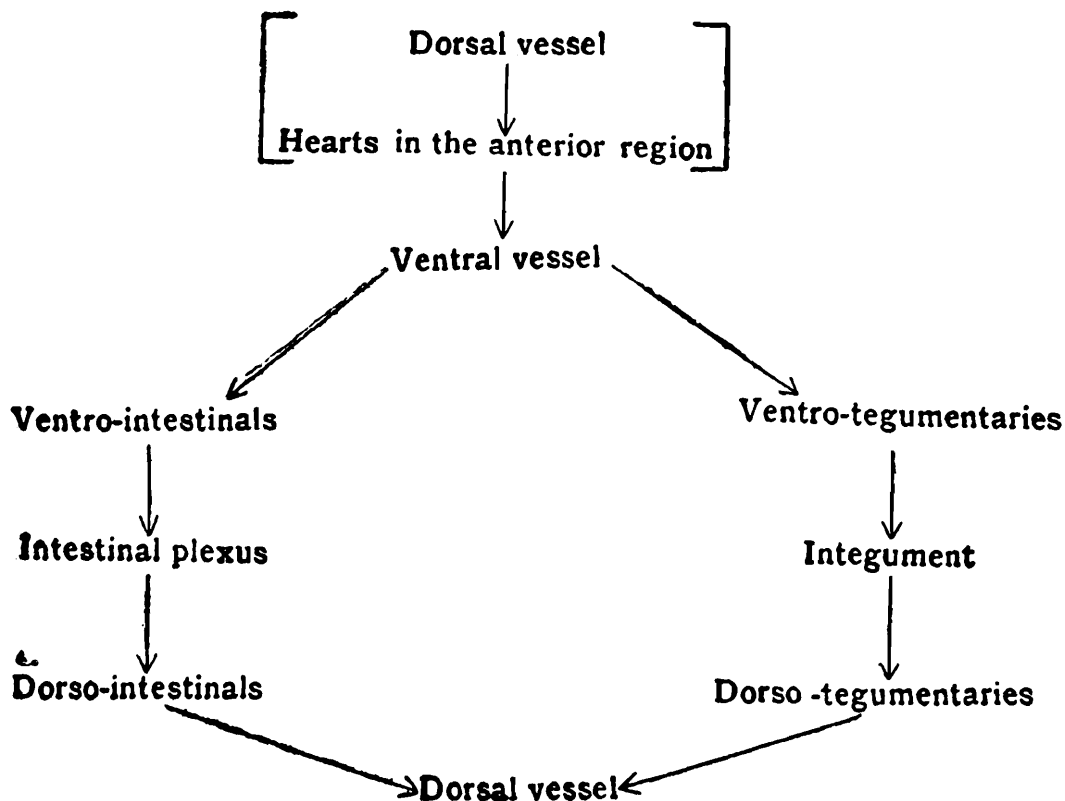
When the ventro-tegmentary vessels are cut, bleeding is observed from the proximal end of the cut, *i.e.* from the side which is attached

to the ventral vessel. The flow of blood is therefore from the ventral vessel to the tegumentary vessel.

Though the ventro-intestinal vessels are very small, it is possible to cut them. When this is done, profuse bleeding is observed from the end which is nearer the ventral vessel, and no bleeding at all from the other end. From this it is evident that blood flows from the ventral vessel into the ventro-intestinal vessel.

I was not able to study the course of circulation in the intestinal plexus. The intestinal plexus consists, as we have seen already, of a very fine close capillary net-work lying between the epithelial and muscular layers of the intestine. Since the flow of blood is from the ventral vessel to the gut-wall and from there through the dorso-intestinals to the dorsal vessel, it may be inferred that the course taken by the blood in the intestinal plexus is from the ventral side to the dorsal round the gut-wall.

To sum up, the blood from the ventral vessel in the intestinal region takes either of the following two courses:—(1) through ventro-tegu-



TEXT-FIG. 7. A diagrammatic representation of the course of circulation in the intestinal region.

mentaries to the body-wall, nephridia and from there, through the dorso-tegmentary vessels to the dorsal vessel, or (2) through the ventro-intestinals to the intestinal plexus, and from there, through the dorso-intestinals to the dorsal vessel.

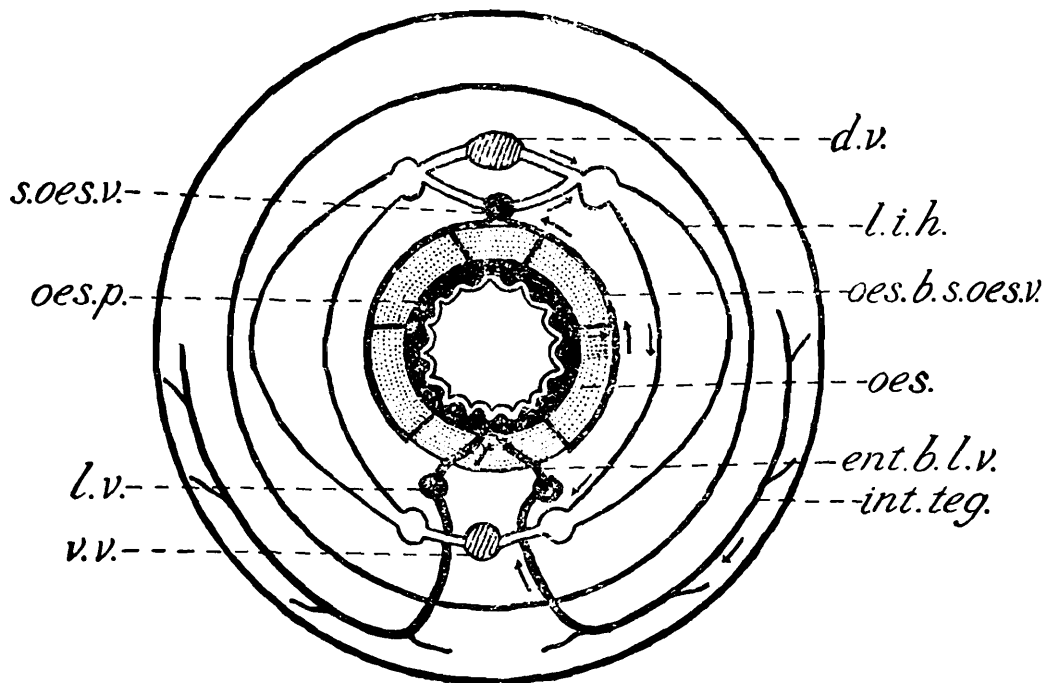
Considering the function of distributing blood to the various parts of the body, the ventral vessel and its branches are arterial, whereas the dorsal vessel and its branches, which receive blood and send it to the hearts situated in the anterior region, are venous in the intestinal region.

2. Circulation in the Anterior region (Segments I to XIII).

The arrangement of the blood vessels in the anterior region is very specialised and there is a corresponding change in the course of circulation.

In the segments anterior to XIV, as compared with what is seen in the intestinal region, there are two important peculiarities, *viz.* (1) all the vessels connected with the dorsal vessel receive blood from it, and (2) the ventral vessel communicates only with the hearts and not with other vessels.

The complete course of circulation in the anterior region is as follows:—At each contraction most of the blood in the dorsal vessel flows down the hearts to the ventral vessel. From the hearts a part of the blood passes through the latero-tegmentaries to the integument, nephridia, and spermathecae. It will be seen that the integument gets its blood, not from the branches of the ventral vessel as in the intestinal



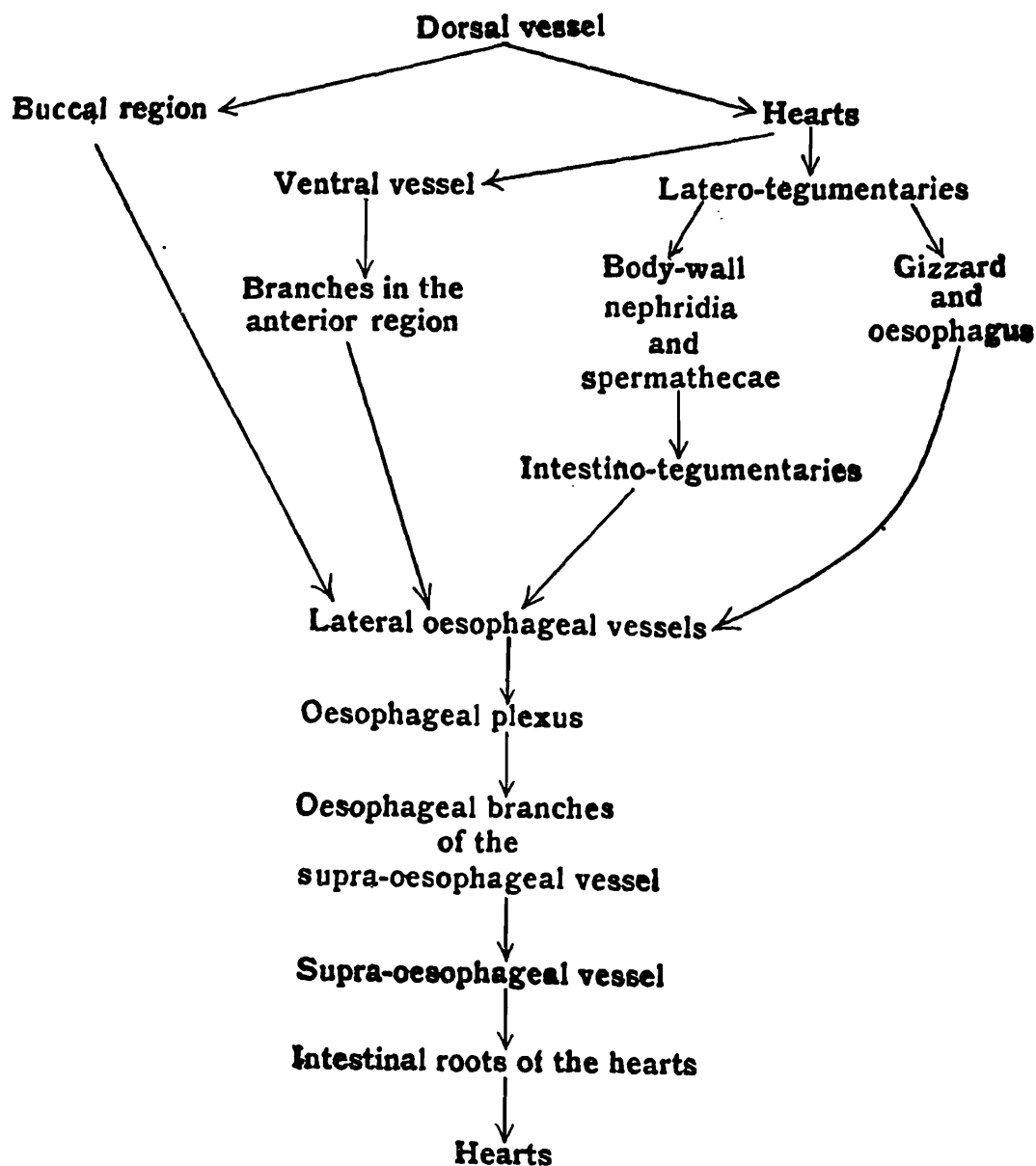
TEXT FIG. 8. A diagrammatic sketch showing the course of circulation in the region of the hearts.

d. v. dorsal vessel; *ent. b. l. v.* enteric branch of the lateral oesophageal vessel; *int. teg.* intestino-tegmentary; *l. i. h.* latero-intestinal heart; *l. v.* lateral oesophageal vessel; *oes.* oesophagus; *oes. b. s. oes. v.* oesophageal branch of the supra-oesophageal vessel; *oes. p.* oesophageal plexus; *s. oes. v.* supra-oesophageal vessel; *v. v.* ventral vessel.

region, but from the branches arising from the hearts. A part of the blood flowing in the dorsal vessel passes through a forward branch of the vessel to the buccal region.

The direction of flow in the ventral vessel is forwards in front of the hearts and backwards behind the hearts. The blood flowing forwards in the ventral vessel circulates in the capillaries of the ventral vessel in the anterior most segments, *viz.* I and II. From this region as well as from the buccal region the blood flows into the lateral oesophageal vessels in which blood flows backwards. The blood from the integument and nephridia also flows into the lateral oesophageal vessels through

the "intestino-tegmentaries" which join the lateral oesophageal vessels. Thus all the returning blood in the anterior region is gathered



TEXT-FIG. 9. A diagrammatic representation of the course of circulation in the anterior region (parietal vessels not included).

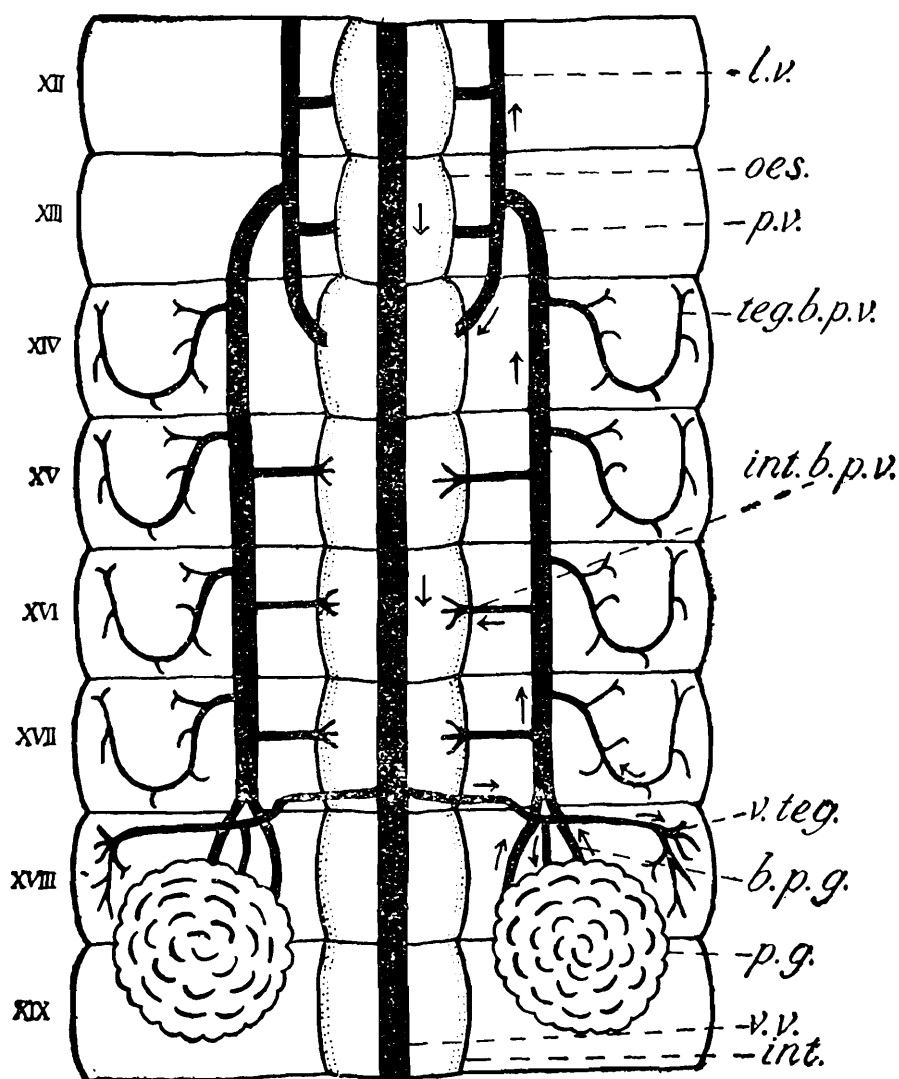
into the lateral oesophageal vessels from where it passes through the enteric branches into the oesophageal plexus which is situated in the wall of the oesophagus from segment VII to XIV

After circulating through the oesophageal plexus the blood flows through the oesophageal branches of the supra-oesophageal vessel into the supra-oesophageal vessel itself, whence it is returned into the hearts through the "intestinal" branches of the heart. In addition to the general course of circulation from the dorsal vessel to the ventral vessel and back to the dorsal vessel through the intervening vessels of the segments behind XIII, there is seen in this region a secondary passage or "short-circuit" through vessels connected with the hearts and lateral oesophageals.

3. *Circulation in the parietal vessels.*—The parietal vessels receive blood from the integument and prostate glands. From the parietal

vessels the blood takes either of the two following courses (1) through the intestinal branches of the parietal vessel into the intestinal plexus from where through the dorso-intestinals into the dorsal vessel and (2) forward into the lateral-oesophageal vessel from where it is conveyed through the enteric branch of the lateral oesophageal vessel into the oesophageal plexus, whence it is returned through the oesophageal branches of the supra-oesophageal into the supra-oesophageal vessel itself.

Comparison with other types.—With regard to the general disposition of the major blood vessels and the general course of circulation, *Lampito mauritii* agrees with forms like *Octochaetus*, *Pheretima*, and *Megascolex coeruleus*, but in the details of circulation there are several differences.



TEXT FIG. 10. Sketch showing the origin and distribution of the parietal vessels, and also the course of circulation of blood in them.

b. p. g. branch from the prostate gland; *int.* intestine; *int. b. p. v.* intestinal branch of the parietal vessel; *l. v.* lateral oesophageal vessel; *oes.* oesophagus; *p. g.* prostate gland; *p. v.* parietal vessel; *teg. b. p. v.* tegumentary branch of the parietal vessel; *v. teg.* ventro-tegumentary; *v. v.* ventral vessel.

(1) The presence of only six pairs of contractile hearts extending from segments VIII to XIII, of which four are latero-intestinal, (2) the double nature of the dorsal vessel posterior to the gizzard, (3) and the presence of the sub-intestinal vessel mark off *Octochaetus* from *Lampito mauritii*.

As compared with *Pheretima*, *Lampito mauritii* lacks (1) the "cephalic" blood vessels arising directly from the dorsal and ventral vessels, (2) the sub-neural vessel, (3) the double blood supply to the gut through a single ventro-intestinal, and also from the sub-neural through the septo-intestinal, (4) two intestinal plexuses, and (5) the commissural vessels connecting the dorsal and sub-neural vessels in each segment.

(1) In the presence of a single dorsal vessel, (2) in the possession of eight pairs of hearts, and (3) in the absence of a sub-neural, *Lampito mauritii* resembles *Megascolex coeruleus*. But in the presence of (1) a double supra-intestinal, and (2) a definite intestino-tegumentary system in each segment the latter species is strikingly different. It may also be pointed out that of the eight pairs of hearts in *Megascolex coeruleus*, the anterior three pairs are lateral hearts and the remaining five pairs are latero-intestinal hearts, while in *Lampito mauritii* there is only one pair of lateral hearts, the anteriormost, while the rest are latero-intestinal hearts.

Lampito mauritii differs widely from *Lumbricus* in the arrangement of blood vessels and in the course of circulation.

SUMMARY.

1. The blood-circulatory system of *Lampito mauritii* consists of two main longitudinal vessels, the dorsal vessel and the ventral vessel, extending from one end of the animal to the other, and of nine types of subsidiary vessels in addition to an alimentary plexus. The subsidiary vessels are (1) the supra-oesophageal vessel, (2) the lateral oesophageal vessel, (3) the hearts, (4) the dorso-tegumentaries, (5) the dorso-intestinals, (6) the ventro-tegumentaries, (7) the ventro-intestinals, (8) the intestino-tegumentaries, and (9) the parietal vessels.

2. The dorsal vessel is single and connected with the ventral vessel by eight pairs of contractile hearts, a pair occurring in each of the segments, VI to XIII. Of these the first pair are the lateral hearts and the remaining seven pairs are latero-intestinal hearts having connection dorsally both with the dorsal and the supra-oesophageal vessels.

3. The ventral vessel behind segment XIII gives off the ventro-tegumentaries to the body-wall, but in the anterior region, in segments VI, VII and VIII, the blood to the body-wall, gizzard, oesophagus, nephridia, spermathecae etc., flows through vessels which arise from the hearts and are named in this paper *latero-tegumentaries*. They correspond to the ventro-tegumentaries of the anterior region of some authors.

4. The dorsal vessel is contractile and the blood in it flows from behind forwards. The dorsal vessel behind segment XIV is a great collecting vessel which receives blood from the intestinal wall and body-wall through the dorso-intestinals and the dorso-tegumentaries. Anterior to segment XIV the dorsal vessel sends out blood into branches and is therefore arterial, while posterior to segment XIII it collects the blood from its branches and therefore venous.

5. The blood from the anterior or buccal region flows through the lateral oesophageals into the oesophageal plexus, whence it flows into

the supra-oesophageal through branches proceeding to it from the oesophagus. From the supra-oesophageal vessel the blood flows into the hearts through the intestinal roots of the hearts. The lateral oesophageals on the ventral side of the oesophagus and the supra-oesophageal on the dorsal side constitute the two chief additional longitudinal venous vessels in the anterior region (segments I to XIV).

6. The ventral vessel is non-contractile and receives blood from the hearts. The flow of blood in the ventral vessel is backwards behind the hearts, and forwards in front of the hearts. Behind segment XIV the blood leaves the ventral vessel through ventro-intestinals and ventro-tegmentaries to the gut-wall and body-wall respectively, whence it is returned as stated above into the dorsal vessel. Anterior to segment XIV the blood from the ventral vessel flows forwards towards the anteriormost region, where it is distributed by the branches borne by it, and thence returned into the lateral oesophageal vessels.

7. Sub-neural and sub-intestinal vessels are absent.

8. The arrangement of the blood vessels in the region of the intestine is typical.

9. The lateral oesophageal vessels may be considered to be specialized vessels of the intestino-tegmentary system, as they are intimately connected with the intestine and the integument through their branches.

10. A pair of parietal vessels is present connected in segment XIII with the lateral oesophageal vessels, with the vessels in the integument in segments XIV to XVII, with the intestine in XV, XVI and XVII and with the prostate glands in XVIII.

They return blood from the skin and prostate glands partly directly into the intestinal plexus and partly indirectly through the lateral oesophageal vessels.

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¹ This reference was not available to me, and I have, therefore, consulted the summary of this paper in Maurice Bleakly's work.

