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THE ORIENTAL TIPULIDAE IN THE COLLECTION OF THE INDIAN MUSEUM.

PART I.

By CHARLES P. ALEXANDER, *Amherst, Massachusetts, U. S. A.*

(Contribution from the Department of Entomology, Massachusetts Agricultural College.)

(Plate XIII.)

Through the kindness of Dr. B. N. Chopra, Assistant Superintendent of the Zoological Survey of India, I have been privileged to examine very large and valuable series of crane-flies (Family Tipulidae, Order Diptera) from various parts of British India, Japan and other states and countries of Eastern Asia. In the present part, I have described certain of the novelties contained in this series and have given additional notes on certain of the more uncommon of the previously described forms. All types and uniques from this series have been returned to Dr. Chopra and will be placed in the Indian Museum. I have taken this opportunity of describing two additional Oriental Tipulidae that were preserved in my own collection. I wish to express my deepest gratitude to Dr. Chopra, and to the other collectors of this material, for their kind interest in making known the vast Tipulid fauna of British India. It must be realized that our knowledge of these flies, their exact geographical and seasonal range, their ecological relations and life-histories, and their inter-relationships, have scarcely been touched, in so far as the Indian fauna is concerned, despite the very detailed collections made by the members of the staff of the Zoological Survey of India and the voluminous reports on the same by the late Mr. Brunetti. To obtain this detailed knowledge will require the best efforts of many generations of men and the present series of papers must be considered as being only a humble contribution to this very involved subject.

Practically all of the recent work on the Tipulidae of British India has been done by Brunetti, in a series of reports that appeared between 1911 and 1918. Brunetti's work was accomplished under a handicap of lack of literature and authentically named material from other parts of the Holarctic and Oriental Regions, and this serious deficiency probably accounts in large measure for many of the erroneous generic assignments that have been discussed by Bergroth, Edwards, the present writer and other students of the group, in various papers that need not be listed here. It may be affirmed that no lasting work on this vast fauna can be done without a knowledge of the Palaearctic and other portions of the Oriental Regions.

PREOCCUPIED NAMES.

Certain of the names used by Brunetti in the Tipulidae are primary homonyms of earlier names, and by the rules of all zoological codes

must be re-named. The writer informed Mr. Brunetti of this fact many years ago but since he did not deem it advisable to alter these preoccupied names (*Rec. Ind. Mus.*, XV, p. 274 ; 1918), it has become necessary to make certain changes at this time.

Certain of these names were changed in an earlier paper (*Insec. Inscit. Menst.*, IX, p. 180 ; 1921) and are listed here only for completeness :—

Limonia garoensis Alex., for *L. longipennis* Brun., preoccupied.

L. brunettii Alex., for *L. nigra* Brun., preoccupied. Edwards believes this to be identical with *L. bidentata* Skuse, which is thus the earliest name.

Erioptera bengalensis Alex., for *E. flava* Brun., preoccupied. Brunetti later stated that *flava* was a synonym of his *E. halterata*. If this is true, the latter name will be used but the writer is by no means convinced of this identity, which can be settled only by a detailed comparison of the types.

Limnophila (*Dicranophragma*) *venustipennis* Alex., for *L. pulchripennis* Brun., preoccupied.

Tipula perelegans Alex., for *T elegans* Brun., preoccupied.

The following names proposed by Brunetti are likewise excluded as being primary homonyms of earlier names :—

Tipula immsi, n.n., for *T splendens* Brun. (*Fauna*, p. 314 ; 1912), *nec T splendens* Doane (*Journ. N. Y Ent. Soc.*, IX, p. 107 ; 1901).

Tipula rufoabdominalis, n.n., for *T rufiventris* Brun. (*Rec. Ind. Mus.*, XV, p. 268 ; 1918) *nec T rufiventris* Macq. (*Dipt. exot.* suppl. 1, p. 13 ; 1846).

Tipula subvernalis, n.n., for *T fasciculata* Brun. (*Rec. Ind. Mus.*, XV, p. 269 ; 1918) *nec T. fasciculata* Ried. (*Abhand. Lehrerver. Naturk. Crefeld*, 1913, p. 103 ; 1913).

Limnophila (*Dicranophragma*) *recessiva*, n.n., for *L.* (*D.*) *gracilis* Brun. *nec L. gracilis* Wied. (*Aussereur. zweifl. Ins.*, I, p. 28 ; 1928), *nec L. gracilis* Meun., (*Ann. Sci. Nat.*, (9) IV, p. 376 ; 1906). Edwards considers that this species is not a true *Limnophila* but may more possibly be referred to *Cladura*.

TERMINOLOGY.

(The dates in parentheses refer to the Bibliography at the end of this discussion.)

The terminology of the various morphological structures of craneflies is similar to that adopted by me in recent papers, with certain modifications in the venation. During the past quarter of a century, a tremendous advance has been made in the study of insect morphology and our knowledge of the strict homologies of parts is much more exact than was formerly the case. In order that the sources of the morphological terms adopted in this paper may be more readily located, a Bibliography of the papers studied is appended to this caption. Taxonomists owe a vast debt to the unselfish labors of the men cited.

Head and mouth-parts.

The sclerites constituting the head-capsule have been discussed fully by Peterson (1916). The unfortunate use of the term " paraglossae " for structures that are really homologous with the labial palpi has been corrected by Crampton (1925).

Thoracic sclerites and wing-bases.

The cervical and prothoracic sclerites are discussed in detail by Crampton [1925 (*b*), 1926 (*b*)]. The sclerites of the mesonotum (Crampton, 1919) and the pleural regions of the thorax have been considered in detail by Crampton [1925 (*a*), 1926 (*a*)] and Snodgrass (1909). The last is a noteworthy paper but the homologies of certain of the parts have been changed as a result of later studies. The report by Young (1921) pays special attention to the lateral sclerites of the posterior regions of the thorax and their attachment to the abdomen.

Venation.

It is peculiarly unfortunate that Brunetti found the Comstock-Needham system of venation " objectionable " to him (*Fauna of British India, Diptera Nematocera*, p. 563 ; 1912). His adherance to the cumbersome and antiquated nomenclature of the Schinerian school, even as modified and amplified by Osten Sacken, Verrall and others, has added vastly to the labors of all future Dipterologists in revising the vast fauna of the Indian Empire. I would very much call in question Brunetti's statement (*l.c.*, p. 25) that the Schinerian system of venation has been " almost universally adopted " for the Diptera. The Comstock-Needham system is based on the strict homologies of veins for all orders of insects and has been accepted by the majority of the younger taxonomic workers in all orders where venation is applicable. The proof of its almost universal use is shown by the fact that *all* of the leading text-books that have appeared in the past decade have accepted this terminology without question (*General Morphology* : Comstock, 1924 ; Schröder, by Handlirsch, 1925 ; Imms, 1925 ; MacGillivray, 1923 ; and Tillyard, 1926). This system of venation, as fully discussed by Comstock (*Venation* : 1918), has been materially changed by later discoveries by Tillyard (1919, 1926). These discoveries involve the medial and cubital fields of the wing, the rudimentary branch lying behind Cubitus (Pl. XIII, figs. 1 and 10) that was considered as being a reduced 1st Anal vein by Comstock (1918), Alexander (1919) and MacGillivray (1923), being shown by Tillyard to be the second branch of Cubitus (Cu_2). It should be noted that Williston much earlier had detected this vein and correctly associated it with the Cubital vein. The vein that was held by Comstock and others as being Cu and Cu_2, in longitudinal alignment, is considered by Tillyard as being the two sections, separated by *m-cu*, of the vein Cu_1 (Pl. XIII, figs. 1—10). The branch held by Comstock and Needham to be the distal section of Cu_1 is, by the Tillyard modification, M_4 (Pl. XIII, figs. 1—10). The writer is convinced of the correctness of these Tillyard modifications and has adopted them in all of his recent papers on the Tipulidae. There remains an important consideration of the radial field that has been discussed in a detailed paper by me (1927), still in press. This modification was discussed for the Cylindrotominae (Alexander, 1919) and the Pediciini (Alexander, 1918) but had never

been applied throughout the family until the study above cited. These results are mentioned here because the changes involved have been adopted by me and it seems advisable to keep the present series of papers uniform in this respect. In brief, it may be stated that there are two distinct lines of modification in the Tipulidae, one which has been evolved from some ancestor not unlike the Architipulinae and has lead to the recent Tipulinae, Cylindrotominae, and the Limoniine tribes Lechriini and Limoniini (Pl. XIII, figs. 1—6). In all of these groups the radial crossvein, *r*, is present but lies in a *longitudinal* position and thus simulates a section of the main longitudinal radial vein. The modifications of this field of the wing are brought about by the atrophy of the distal section of R_1, as in many Cylindrotominae, Lechriini (Pl. XIII, fig. 3) and Limoniini (Pl. XIII, fig. 4). In the Tipulinae, the distal section of R_1 is persistent but the distal section of R_2 has been entirely lost by atrophy in many genera and species (as the Dolichopezaria). In the higher Cylindrotominae, the distal sections of both R_1 and R_2 are atrophied, giving the appearance of a long backward fusion of veins R_1 and R_{2+3}, a condition that is merely apparent, as has been discussed by me in earlier papers (1919). The posterior branch of the radial field in the groups above cited is R_{4+5}.

The remaining tribes of the Limoniinae (the Pediciini, Hexatomini and Eriopterini, Pl. XIII, figs. 7—10) represent an entirely distinct branch of the family and have apparently been evolved through some Tanyderid-like ancestor, as was discussed by me in an earlier paper (1918). This is well shown by the remarkable crane-fly, *Tricyphona protea* Alex. (Pl. XIII, fig. 7), where the upper branch of the sector, R_2, is shown as fusing backward from the wing-margin with the extreme tip of R_1. The most generalized group is the Pediciini (Pl. XIII, figs. 7—8), where this condition is retained, together with the hairy eyes of the Tanyderoid ancestor. The branch R_2 in almost all members of this group of tribes has shortened into a transverse element that has been interpreted by all students as being the true radial (marginal) crossvein, *r*, in the Diptera. The impossibility of such an interpretation has been discussed in detail in the paper cited (1927). The end-result of this tendency of cephalization is a short to longer fusion back from the wing-margin of veins R_1 and R_2 (Pl. XIII, figs. 7—10). It should be noted here that the true radial crossvein, *r*, has never been developed in this group of tribes, and that it has never appeared in the order Diptera as a *transverse* element, as was heretofore considered. In the higher tribes and subtribes of this division of the Tipulidae, the anterior branch of the posterior fork of the sector, R_4, in generalized forms held in a dichotomous fork with R_5 (Pl. XIII, fig. 7) has moved cephalad (Pl. XIII, fig. 8) and become more intimately attached to R_{2+3} (Pl. XIII, figs. 9—10), forming a short to longer fusion, R_{2+3+4}. This tendency has been called by me " the capture of vein R_4 by R_{2+3} " and is of common occurrence in the Pediciini, Hexatomini and Eriopterini. This cephalad migration of vein R_4 leaves the posterior branch of the radial field in this group of tribes to consist of R_5 alone. The further modifications in the group, the loss by atrophy of the transverse basal section of R_2 in many genera, and the fusion outwardly, in cases even to the wing-

margin, of veins R_3 and R_4 in other groups, have been outlined in the more detailed paper cited (1927) and need not be discussed here.

As an aid in the correlation of the venational system used by Brunetti and that adopted by me, the following table of comparisons is given :—

COMPARISON OF THE VENATIONAL SYSTEMS OF BRUNETTI AND ALEXANDER.

Brunetti.	Alexander (Tipulinae, Cylindrotominae, Lechriini, Limoniini).	(Pediciini, Hexatomini, Eriopterini).
VEINS.		
costa	*C*	*C*
auxiliary	$Sc+Sc_1$	$Sc+Sc_1$
1st longitudinal	$R+R_1+r$ ($+R_2$ in Limoniini)	$R+R_1+R_{1+2}$
2nd ,,	$Rs+R_{2+3}$, with R_2 and R_3	$Rs+R_{2+3+4}$, with R_2 and R_3.
3rd ,,	R_{4+5}	R_5
4th ,,	*M* with its branches	*M* with its branches.
5th ,,	Cu_1	Cu_1
6th ,,	*1st A*	*1st A*
7th ,,	*2nd A*	*2nd A*
praefurca	$Rs+R_{2+3}$	$Rs+R_{2+3+4}$
humeral crossvein	*h*	*h*
subcostal ,,	Sc_2	Sc_2
costal ,,	distal section R_1	lacking
anterior ,,	*r - m*	*r - m*
discal ,,	*m*	*m*
marginal ,,	lacking (Tipulini) or basal section of R_2.	basal section of R_2
posterior ,,	*m-cu*	*m-cu*
CELLS.		
costal	*C*	*C*
subcostal	*Sc*	*Sc*
1st basal	*R*	*R*
2nd ,,	*M*	*M*
1st marginal	*1st* R_1	R_1
2nd ,,	*2nd* R_1	R_2
1st submarginal	R_2	R_3
2nd ,,	R_3	R_4
1st posterior	R_5	R_5
2nd ,,	M_1	M_1
3rd ,,	*2nd* M_2	*2nd* M_2
4th ,,	M_3	M_3
5th ,,	M_4	M_4
discal	*1st* M_2	*1st* M_2
anal	*Cu*	*Cu*
1st axillary	*1st A*	*1st A*
2nd ,,	*2nd A*	*2nd A*

(*Explanation of venational symbols* : *A*=Anal ; *C*=Costa ; *Cu*=Cubitus ; *h*=humeral crossvein ; *M*=Media ; *m*=medial crossvein ; *m-cu*=medial-cubital crossvein ; *R*=Radius ; *r*=radial crossvein ; *r-m*=radial-medial crossvein ; *Rs*=Radial sector ; *Sc*=Subcosta.)

While discussing the Schinerian system of venation, it may not fall amiss at this point to call attention to the fact that Williston's version of the same differed in several important respects from Brunetti's, as given above. Thus, Williston's 5th longitudinal included as its first

branch what Brunetti calls the last branch of the 4th longitudinal (M_4); Williston also included the rudimentary branch of Cubitus (Cu_2), ignored by Brunetti, as a branch of his 5th longitudinal, giving to this important vein a three-branched condition. Similarly, Williston's 2nd marginal cell was what Brunetti would call 1st submarginal, his submarginal cell being Brunetti's 2nd submarginal.

MacGillivray (1923, both references) has discussed the highly reduced anal veins in the axillary region of the wing. It is unfortunate that no one has yet made a detailed study of the prearcular veins in the Tipulidae.

Genitalia.

The fundamental paper on the Tipulid hypopygium of the male is by Snodgrass (1904). His terminology is in part slightly incorrect but the discussion of structures involved is of the greatest possible value. The homologizing of the structures termed "*pleurites*" by Snodgrass as being the *basistyles*, and the so-called "*apical appendages*" of Snodgrass as the *dististyles* is due to Crampton (1923). The *basistyles* have been termed by various authors the *pleurites*, *side-pieces*, *basal segment of the clasper*, and other terms ; the *dististyles* have been variously termed *pleural appendages*, *claspers*, *outer* or *distal segment of the claspers*, and similarly. Since their true morphological homologies have been demonstrated, I have adopted the new terms. The structure of the female genitalia has been considered in detail by Snodgrass (1903).

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Subfamily *TIPULINAE.*

Tribe TIPULINI.

Brithura phaedina, sp. nov.

Mesonotum dark slate grey with four narrow brownish black stripes, the intermediate pair bordered by subochreous ; scutal lobes each with

two velvety brownish black spots ; femora with a narrow dark brown subterminal ring, the extreme tips reddish ; wings brown, the caudal half paler, the surface very sparsely variegated with yellowish markings ; stigma brownish black ; *r-m* at or before the fork of *Rs* ; abdomen largely fulvous-orange, the lateral margins of the tergites and the terminal segments darker.

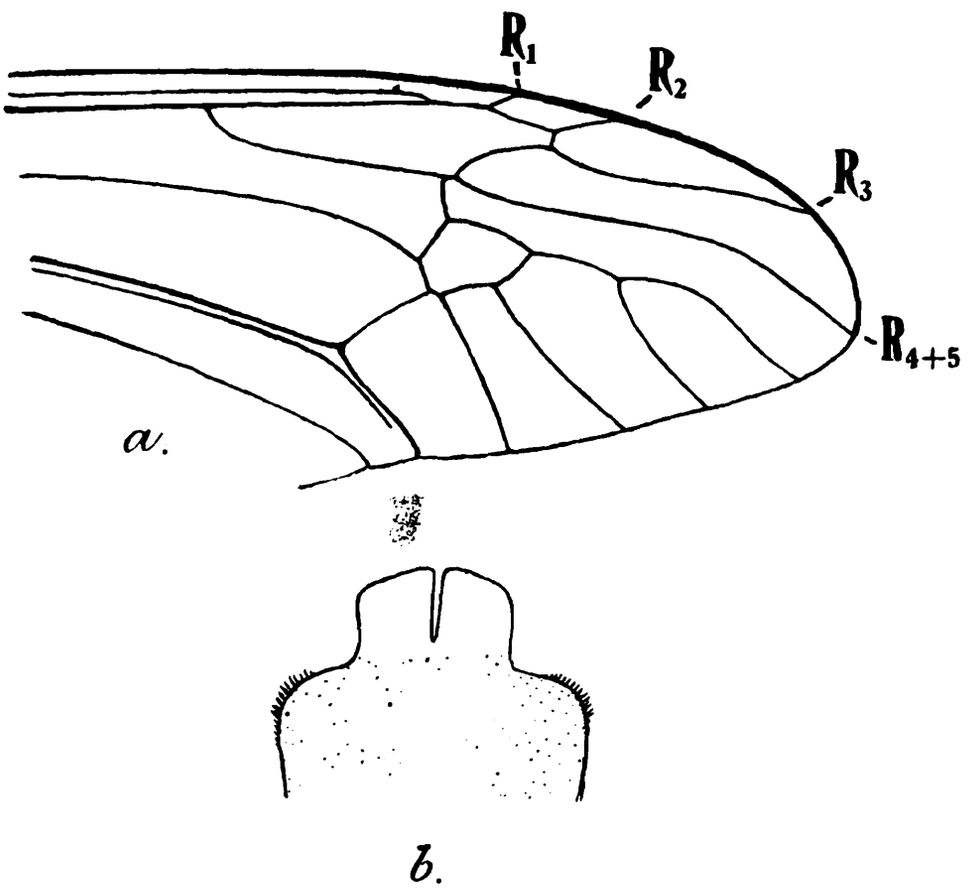
Male.—Length about 24 mm. ; wing, 18 mm.

Female.—Length about 33 mm. ; wing, 20—21 mm.

Frontal prolongation of the head dark brown, the nasus represented only by a small obtuse protuberance ; palpi brownish black. Antennae dark brown, the second segment narrowly ringed apically with fulvous ; flagellar segments pruinose, with conspicuous basal verticils. Head light brown, the high vertical tubercle a trifle bifid, the latter and a line extended caudad onto the posterior vertex darker brown, the pale coloration extended around the eye onto the anterior orbits.

Pronotum dark brown. Mesonotal praescutum dark slate-grey with four conspicuous brownish black stripes, the very elongate intermediate pair bordered by a paler subochreous line, the one dividing the two stripes being a trifle the wider ; intermediate stripes narrowed gradually behind, attaining the suture as a narrow point ; lateral stripes relatively short and narrow, each surrounded by a pale grey ring ; interspaces with dense erect black setae ; scutum grey, each lobe with two circular velvety brownish black spots that are very narrowly and indistinctly ringed with paler grey, the posterior spot a little the larger ; scutellum and postnotum dark grey, with conspicuous setae. Pleura chiefly dark brown, vaguely variegated with paler, especially on the restricted sternopleurite ; dorsopleural region paler brown. Halteres obscure yellow, the knobs infuscated. Legs with the coxae and trochanters generally dark in color ; femora brown, more yellowish basally, the extreme tip narrowly reddish, preceded by a subequal still darker brown ring ; remainder of legs dark brown. Wings with a strong brown tinge, especially on the cephalic half, the caudal half paler, the membrane sparsely variegated with yellow, the stigma brownish black ; cell *C* dark brown except at outer end ; cell *Sc* largely pale ; the yellow markings are as follows : the largest a semicircular area beyond the stigma in cells *2nd* R_1, base of R_2, across the basal third of R_3, thence directed basad as a narrow line in the base of cell R_5, the point almost reaching the cord ; a small yellow mark immediately before the stigma and larger ones before and beyond the origin of *Rs* ; a yellow spot along vein Cu_1 in the outer quarter of cell *M* ; small marginal yellow spots in cells R_5, M_1, *2nd* M_2, M_3, lying at mid-distance between the veins ; two similar spots in the outer end of cell *1st A*, one near each enclosing vein ; narrow darker brown seams along Cu_1 and *m-cu* ; a brown dash at near one-third the length of cell *Cu*, each end with a restricted yellow suffusion ; prearcular region dark ; veins chiefly yellow, much paler than the ground-color, the swollen arcular region conspicuously yellow. Venation (Fig. 1*a*) : *r-m* just before the fork of *Rs* ; *r* nearly longitudinal in position ; basal section of R_2 conspicuous, the distal section without macrotrichiae ; vein R_3 sinuate, less than the basal half with macrotrichiae ;

cell *1st* M_2 high-pentagonal; *m* shorter than the petiole of cell M_1; *m-cu* just before the fork of M_{3+4}.



TEXT-FIG. 1.—*Brithura phaedina*, sp. nov.
a. Wing. *b*. Ninth tergite of ♂ hypopygium.
Symbol: R=Radius.

Abdominal tergites bright fulvous orange, the sides of tergite one slightly infuscated; a narrow lateral line along the tergites and the hypopygium dark brown; sternites fulvous orange, the intermediate segments narrowly ringed caudally with darker, the terminal sternites dark brown. Male hypopygium massive. Ninth tergite (Fig. 1*b*) small, the caudal margin produced into a broad flattened lobe that is profoundly split by a linear incision, the margins of the lateral lobes thus formed obliquely truncated, glabrous or nearly so. The combined ninth sternite and basistyle large, bearing the short, blunt dististyles at apex; sternal region beneath membranous. Eighth sternite very large and conspicuous, extended caudad as a boat-shaped structure beyond the level of the other elements of the hypopygium, the caudal margin with dense brushes and tufts of long black setae and small lobules. Ovipositor with the tergal valves very long and slender, the tips obtuse, the margins smooth; sternal valves only about one-half the length of the tergal valves, straight, the tips subacute.

Hab.—West China; North-west India.

Holotype, ♂, Shin Kai Si, Mt. Omei, Szechuen, China, altitude 4,400 feet (*D. C. Graham*), in the U. S. National Museum.

Allotype, ♀, Simla, Western Himalayas, India, altitude 6,000—7,000 feet, Station 1, August-September 1925, at light (*B. Chopra*),

Paratopotype, ♀, with the holotype.

The nearest ally of this beautiful crane-fly would seem to be *B. pulcherrima* (Brun.), despite the rather striking differences in the structure of the head, male hypopygium and venation.

Brithura pulcherrima (Brun.).

1912. *Tipula pulcherrima* Brun., *Fauna Brit. India, Dipt. Nemat.*, pp. 310—311, pl. v, fig. 8 (wing), pl. vi, fig. 12 (thoracic dorsum), fig. 13 (male hypopygium).

One injured female, Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, at light (*B. Chopra*).

Female.—Length about 36 mm. ; wing, 22 mm. ; abdomen alone 26 mm.

Vertical tubercle scarcely indicated. Nasus virtually lacking, represented only by a minute tubercle.

Despite the lack of the vertical tubercle, there can be little question but that the present species pertains to *Brithura* rather than to *Tipula*. The fly exhibits the other essential characters of the genus : stout hairy body ; relatively small sternopleurite ; short powerful legs, the tibiae longer than the tarsi ; produced region of the eighth sternite of the male hypopygium ; elongate abdomen of female, with long ovipositor of rather unusual form.

The virtual lack of the nasus is exhibited by *B. phaedina*, sp. n., which is certainly a *Brithura*. The retention or loss by atrophy of Sc_1 is not a fundamental character of the genus.

Mitopeza longicornis (Brun.).

1918. *Nesopeza longicornis* Brun., *Rec. Ind. Mus.*, XV, pp. 278—279.

Two females from the type-locality (Above Tura, Garo Hills, Assam, altitude 3,500—3,900 feet, July and August 1917 ; *S. W Kemp*). The female sex has not been described and one of the above specimens is described as allotype.

Female.—Length about 9·5 mm. ; wing, 13—13·5 mm.

Agreeing with the description of the male except in the following particulars :

Antennae shorter, but still elongate ; if bent backward extending about to the root of the halteres ; flagellar segments elongate-cylindrical with elongate unilaterally arranged setae that are a little longer than the segments. Halteres pale, the knobs dark brown. Legs with the femora brown to dark brown but scarcely blackened. Wings with a strong brownish tinge, still darker at the wing-tip, along the cord and as narrow seams along the outer veins ; the white pre-stigmal and post-stigmal spots very conspicuous. Ovipositor with the valves entirely fleshy, very blunt, as in the genotype, *M. nitidirostris* Edw. The spermathecal ducts are relatively short and inconspicuous, not elongate and tangled as in the genotype.

Allotype, ♀, July 1917.

Edwards (*Rec. Ind. Mus.*, XXVI, p. 304 ; 1924) failed to recognize that this species is congeneric with *Mitopeza*. The following observations on the venation of the species may be given :

Sc_2 ending just beyond the fork of *Rs*, Sc_1 nearly atrophied; *Rs* elongate, a little longer than R_{2+3}; R_3 in alignment with R_{2+3} and fully one-half longer; cell *1st* M_2 elongate, gently widened outwardly; basal section of M_2 longer than *m*; distal section of M_3 strongly sinuous, the basal section straight, forming the entire lower face of cell *1st* M_2, as stated by Brunetti; *m-cu* about one-third its length before the fork of *M*; veins M_{1+2} and M_3 united for a short distance beyond the point of departure of M_4; the semi-atrophied Cu_2 almost reaches the wing-margin, as in many Tipulinae; cell *2nd A* relatively wide. Conspicuous obliterative areas at the end of *Rs* and across the veins constituting the proximal end of cell *1st* M_2.

Of the three species described in the genus *Nesopeza* by Brunetti (*Rec. Ind. Mus.*, XV, pp. 278-279; 1918), *albitarsis* is an *Oropeza*, *longicornis* a *Mitopeza*, *picticornis* a true *Tipula*, as already stated by Edwards. On the other hand, the species described by Brunetti as *Dolichopeza costalis* (*l.c.*, pp. 277-278) is a true *Nesopeza*, allied to but distinct from the Japanese *N. geniculata* Alex.

Nesopeza parvicorn is sp. nov.

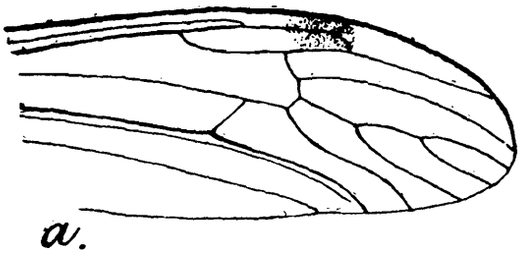
General coloration yellow, the praescutum with three conspicuous reddish brown stripes; scutal lobes and postnotal mediotergite similarly colored; antennae (♂) short; tarsi not evidently brightened; wings brownish yellow, the oval stigma dark brown; *Rs* longer than R_{2+3}; male hypopygium incrassated.

Male.—Length about 7 mm.; wing, 9 mm.

Frontal prolongation of the head short, shiny brownish yellow; palpi elongate, dark brown, the incisures a little paler. Antennae short for this sex, if bent backward not or scarcely attaining the wing-root; scapal segments light yellow, the flagellum dark brown, the first segment paler basally; first flagellar segment elongate-cylindrical, a trifle more than twice the second; second to fifth segments gradually decreasing in size, the last abruptly smaller; flagellar verticils relatively numerous, distributed the entire length of the segment, confined to the outer face of the segment. Head brownish yellow, the vertex broad.

Mesonotum yellow, the praescutum with three conspicuous dark reddish brown stripes, the broader median stripe gradually narrowed behind, not quite attaining the suture; scutum yellow, the lobes virtually covered by confluent brown marks; scutellum brownish yellow; postnotal mediotergite dark brown, the lateral margins narrowly pale. Pleura and pleurotergite yellow, insensibly variegated with pale brown marks on the ventral portion of the anepisternum, the sternopleurite, meron and lower half of the pleurotergite. Halteres relatively long and slender, pale brown. Legs with the coxae and trochanters obscure yellow; femora obscure yellow, the tips rather broadly infuscated; tibiae and tarsi darker brown, the terminal segments of the middle tarsi with the setae more yellowish but scarcely affecting the general dark color; legs of moderate length and slenderness for a member of the Dolichopezaria. Wings brownish yellow subhyaline, highly iridescent, the oval stigma dark brown; veins dark brown; obliterative areas at end of *Rs* and on the basal section of M_{1+2}. Venation: *Rs* of moderate

length, more than one-half longer than R_{2+3}, arcuated ; R_{2+3} about one-third of the long straight R_3 ; forks of medial cells (Fig. 2*a*) of moderate length ; cell M_1 a little less than twice its petiole ; *m-cu* more than one-half its length before the fork of M ; cell M_4 elongate, strongly narrowed outwardly ; cell *2nd A* relatively narrow.



a.

b.

TEXT-FIG. 2.—*Nesopeza parvicornis*, sp. nov.
a. Diagram of venation. *b*. Ninth tergite of ♂ hypopygium.

Abdomen brownish yellow, the basal tergites a little darker medially ; subterminal segments blackened ; hypopygium very large, yellowish brown. Ninth tergite (Fig. 2*b*) with the caudal margin produced caudad into two heavily blackened plates, the tips acutely pointed ; viewed laterally, these tips are directed caudad or very gently decurved.

Hab.—South India.

Holotype, ♂, Kodaikanal, Palni Hills, altitude 6,700—7,000 feet, August 1922 (*S. W. Kemp*).

Nesopeza parvicornis is another species of the Dolichopezaria which might be placed in either *Dolichopeza* or *Nesopeza*. For the time being, at least, I am restricting the name *Dolichopeza* to those species which have *Rs* short and nearly transverse in position. Typical *Nesopeza* represents the opposite extreme and the numerous Oriental species with *Rs* of an intermediate length furnish a problem as to their exact distribution. The present species is well-distinguished by the coloration and short antennae in the male sex. Brunetti is in error in stating (*Fauna*, p. 354 ; 1912) that the obliterative areas are lacking in *Dolichopeza*.

Tipula styligera, sp. nov.

Male.—Length about 14 mm. ; wing about 18 mm.

The type of this species was included in the type-series of *T himalayensis* Brun., which is a close ally.

Frontal prolongation of the head yellow above, with a darker lateral line ; nasus long and slender ; palpi brown. Antennae with the basal three segments yellow, the flagellar segments weakly bicolorous, yellow, with the basal enlargement weakly darkened ; terminal segments more

uniformly darkened ; antennae short, if bent backward not attaining the wing-root. Head golden-yellow, with a capillary dark brown median vitta.

Mesonotal praescutum buffy-yellow, with four olive-green stripes, the intermediate pair margined with bright brown, the lateral stripes similarly bordered along their mesal margins only ; scutum buffy-yellow, each lobe with two olive markings ; scutellum and postnotum brownish yellow, with indications of a capillary darker median line. Pleura yellow, with a faint olive tinge. Halteres brownish yellow, the knobs dark brown, with pale tips. Legs as in *himalayensis*, the broad yellow subterminal ring on the femora distinct. Wings with a faint brownish tinge, the costal cell clearer yellow, except near outer end ; conspicuous yellowish subhyaline areas in the basal cells and as an oblique band beyond the stigma ; the more basal spots are much more abundant than figured by Bagchi for *himalayensis*, there being a larger area almost crossing the wing from cell *R* to the outer end of cell *2nd A* ; wing-axil similarly brightened ; smaller areas before and beyond the origin of *Rs*.

Basal abdominal tergites yellowish, with three brownish black stripes that become more extensive behind ; on the fifth and succeeding tergites including the entire segment ; lateral margins of tergites two to seven narrowly but conspicuously yellow ; sternites brownish black, the lateral margins yellow ; hypopygium dark. Male hypopygium with the ninth tergite small, the caudal margin with a broad U-shaped emargination, the lateral lobes thus formed light reddish, slender, gently diverging from one another. Basistyle large, the main body of the segment only slightly produced, but the extreme apex of each style suddenly produced caudad into a small slender needle-like spine.

Hab.—India.

Holotype, ♂, Darjiling, Eastern Himalayas, altitude 7,000 feet, May 23, 1910 (*E. Brunetti*).

Tipula inaequidentata, sp. nov.

Generally similar to *T styligera*, sp. n., differing especially in the length and structure of the antennae and in the structure of the male hypopygium.

Antennae much longer, in the male, if bent backward, extending about to the base of the abdomen ; basal three segments yellow, the flagellar segments uniformly dark brown.

Mesonotal praescutum blackish, grey pruinose, with three conspicuous olive-green stripes, the median stripe broad, divided by a paler olive median vitta ; scutum dark, each lobe with two contiguous olive-green areas ; scutellum brownish olive ; postnotal mediotergite pale olive with a whitish pruinosity, the posterior fourth dark. Pleura light olive green, the dorso-pleural membrane more buffy. Legs with the pale femoral rings obscure yellow but evident on all the legs. Wings with the pale pattern extensive, the cells before the cord with large, conspicuous, cream-coloured areas.

Abdominal tergites black, the basal segment and lateral margins of the succeeding segments, as well as the caudal margins of segments two to four paler ; hypopygium black. Male hypopygium with the

ninth tergite relatively small, the caudal margin U-shaped, the lateral lobes of this emargination produced caudad into long, very slender, chitinized bars that are directed caudad and lie generally parallel with one another. Between these rods, but slightly more ventrad in position, arise two shorter black, tooth-like spines, their tips gently upturned. Basistyle complete, the apex subtruncate, the dorso-caudad angle produced into a small angular point.

Hab.—India.

Holotype, ♂, Darjiling, Eastern Himalayas, altitude 6,000—7,000 feet, June 12, 1914 (*F H. Gravely*). Sent to me several years ago in exchange with Brunetti ; other specimens are presumably in the Carmichael Collection in the Indian Museum.[1]

Tipula (Acutipula) filicornis mitocera, subsp. nov.

General coloration yellow, the mesonotum with four ill-defined reddish stripes ; antennae (♂) longer than the body, the longest verticils about eight times the diameter of the segments bearing them ; wings, with cell R_2 small ; male hypopygium large and compressed, the sclerites fused into a continuous ring, the ninth tergite gently emarginate.

Male.—Length about 14 mm. ; wing, 16 mm. ; antenna about 15 mm.

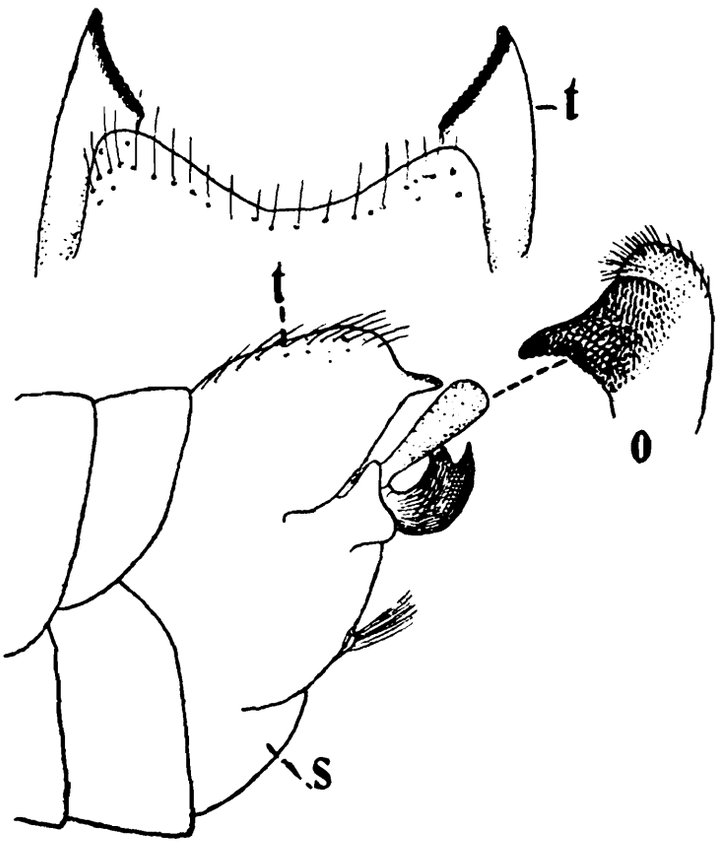
Frontal prolongation of the head yellow, the nasus distinct. Antennae elongate, filiform, the verticils of great length, the longest fully eight times the diameter of the segment and fully twice as long as the more delicate erect setae. Head yellow.

Mesonotal praescutum yellow with four ill-defined reddish stripes, the intermediate pair more distinct, strongly narrowed behind ; scutal lobes yellow, very indistinctly marked with darker reddish yellow ; scutellum and postnotum yellow. Pleura yellow, a very little pruinose. Halteres yellow, the knobs dark brown. Legs with the coxae and trochanters yellow ; femora and tibiae brown, the tarsi darker ; tarsi long and filiform, much longer than the tibiae ; claws of male toothed, as in the subgenus. Wings with a faint brownish tinge, cell *C* slightly darker, *Sc* more strongly suffused with brown ; stigma elongate-oval, brown ; obliterative areas rather restricted ; veins brown. Venation : Cell R_2 small, the distal section of R_2 entire but without macrotrichiae except at base ; cell M_5 deep, more than twice its petiole ; cell *1st* M_2 relatively small ; *m-cu* about three-fourths the distal section of Cu_1, placed on M_4 shortly beyond the origin.

Abdomen brownish orange ; segments six and seven and the bases of eight dark brown to form a subterminal ring ; hypopygium obscure yellow. Male hypopygium (Fig. 3) relatively large and compressed, the tergite and sternite fused. Caudal margin of the ninth tergite (t) rather gently emarginate, the extreme lateral angles further produced caudad into flattened ear-like lobes, the mesal margins of which are blackened and microscopically roughened. Outer dististyle (o), viewed laterally, appearing as a yellow subglabrous rod, its mesal face produced into a point, the entire inner face of the style densely set with

[1] There is no specimen of this species in the Indian Museum. [H. S. P.]

microscopic spinulae. From the notch of the sternite (s) juts a small median lobe, bearing terminal brushes of setae.



Text-fig. 3.—*Tipula filicornis mitocera*, subsp. nov. ; ♂ hypopygium. Symbols : o=outer dististyle ; s=9th sternite ; t=9th tergite.

Hab.—India.

Holotype, ♂, Sureil, Mangpu, Darjiling District, altitude 5,000 feet, April-May 1917 (*S. W Kemp*).

I cannot indentify this fly with *T. filicornis* Brun. (*Rec. Ind. Mus.*, XV, pp. 267-268 ; 1918) because of the entire lack of any gray coloration on the head or mesonotum. Edwards (*Ibid.*, XXVI, p. 306 ; 1924) gives some supplementary notes on the type of *filicornis*. The elongate verticils of the antennae are described as being only about five times as long as the diameter of the segment and the tip of the ninth tergite as being rounded.

The fly belongs to the subgenus *Acutipula* Alex., a subgeneric group which is greatly developed in the Ethiopian Region, extending eastward into the Original Region, as far east as Northern Australia. It is probable that rather numerous species of this group will be found in India and that some of the species described by Brunetti pertain here.

Nephrotoma pleuromaculata, sp. nov.

General coloration sulphur-yellow, the praescutum with three shiny black stripes ; scutal lobes, scutellum and posterior margin of the postnotal mediotergite black ; pleura yellow with a conspicuous black triangle on the anepisternum ; legs yellowish ; wings subhyaline, cell *Sc* and the stigma dark brown ; cell *1st* M_2 very small ; cell M_1 petiolate ; abdominal

tergites orange, tergites one to five with the caudal margin of the segments black; tergite six entirely black; terminal segments fulvous-orange.

Female.—Length about 18 mm.; wing, 13—14 mm.

Frontal prolongation of the head yellow, dark brown dorso-medially and laterally at base; palpi obscure yellow, the terminal segment dark brown. Antennae with the basal segment yellow, the second segment brownish yellow; flagellar segments brownish black. Head light yellow with the occipital band small, triangular, inconspicuous; a small brownish area on sides of vertex near the narrowest point; vertical tubercle moderately conspicuous, weakly bifid, paler sulphur-yellow than the disk of the vertex.

Pronotal scutum broadly sulphur-yellow medially, brownish black laterally; scutellum yellowish laterally. Mesonotal praescutum light sulphur-yellow with three shiny black stripes, the lateral stripes a trifle outcurved but not produced toward the margin; scutum yellow, the lobes virtually concealed by oblique shiny black marks that converge to the similarly blackened scutellum; sides of the scutal lobes and the mesal portions of the parascutella yellow, the posterior margins of the latter black; a narrow black line extends from the cephalic portion of the scutal lobes laterad to the wing-root; postnotum light sulphur-yellow, with about the posterior third or a little less blackened; pleurotergite yellow, variegated with black as a posterior and dorsal border. Pleura yellow with a large triangular black area that almost covers the anepisternum, the apex directed dorsad; similar but smaller blackened areas on the cephalic margin of the pteropleurite and the caudal margin of the anepisternum; ventral portions of sternopleurite and meron fulvous. Halteres brown, the knobs yellow. Legs with the coxae and trochanters fulvous; femora brownish yellow, the tips scarcely darkened; tibiae yellowish brown, the tips narrowly infuscated, the tarsi passing into dark brown; (fore-legs broken). Wings subhyaline, cell *Sc* entirely dark brown; stigma similarly dark brown; in cases, a very vague brown cloud on anterior cord and a similar suffusion along *Cu* and *m-cu*; veins dark brown. Venation: Sc_2 ending opposite the origin of *Rs*; cell *1st* M_2 very small; cell M_1 petiolate, the petiole variable, from shorter than *m* to a little longer than this vein; M_{3+4} forking at end of *M*, *m-cu* some distance beyond the origin of M_4; vein Cu_2 almost reaching wing-margin.

Abdomen orange, tergites one to five with the caudal margins broadly ringed with black, on the first tergite more triangular and not reaching the lateral margins; tergite six entirely black; tergite eight black at extreme base; remaining segments of abdomen fulvous-orange, the valves of ovipositor darker; sternites largely concealed by the overlapping tergites, apparently obscure yellow, with a subterminal chiefly blackish ring, as above.

Hab.—India.

Holotype, ♀, Mahananda River, near Siliguri, base of the Eastern Himalayas, March 16, 1924 (*B. N. Chopra*).

Paratopotype, ♀.

By Brunetti's key (*Fauna*, pp. 340—341; 1912), the present species runs to *N. pleurinotata* (Brun.), a distinct species. It should be noted

that *N. javensis* (Dol.) is not so variable as supposed by Brunetti and that he had confused more than a single species.

Subfamily *LIMONIINAE.*

Tribe LIMONIINI.

Rhipidia (Rhipidia) choprai, sp. nov.

General coloration of the mesonotum rich reddish brown, darkened behind ; antennae (♂) with flagellar segments two to nine bipectinate ; wings (♂) with a sparse costal pattern, the remainder of the wings nearly clear ; wings (♀) with an abundant spotted and dotted brown and grey pattern ; male hypopygium having but three spines on the rostrum of the ventral dististyle.

Male.—Length about 6—6·5 mm. ; wing, 7—7·8 mm.

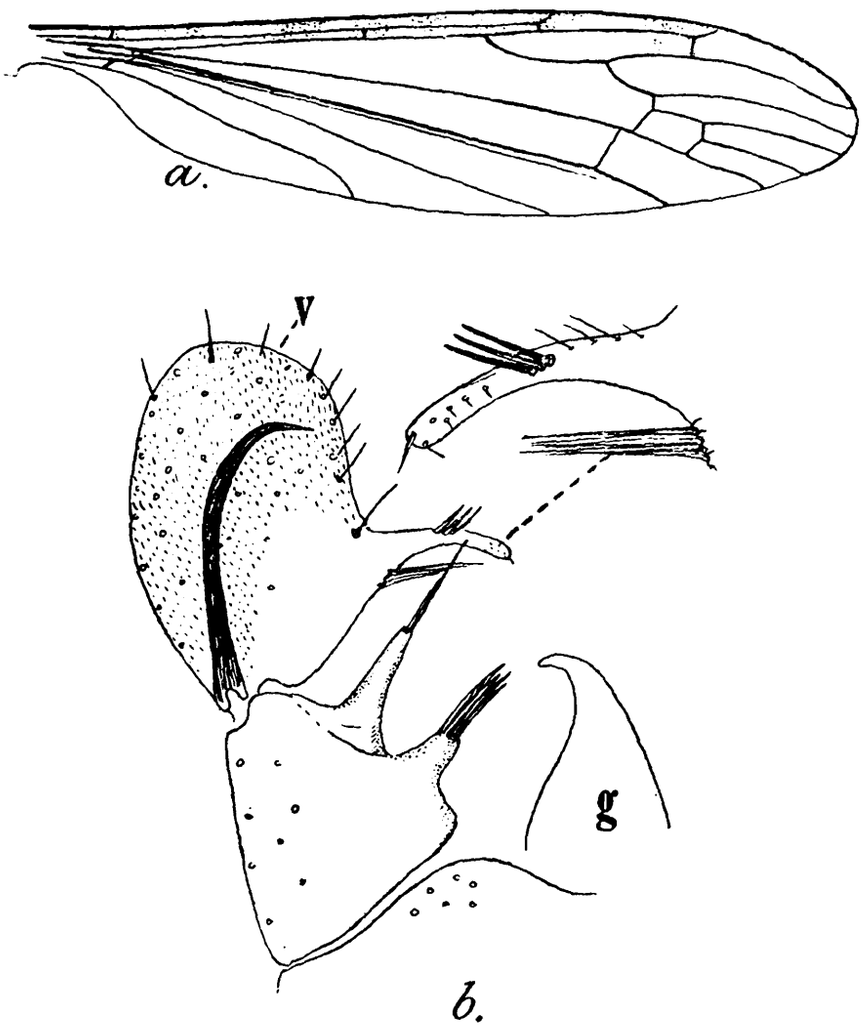
Female.—Length about 7·5 mm. ; wing, 7·8—8 mm.

Male.—Rostrum and palpi black. Antennae long-bipectinate ; scapal segments dark brown ; flagellar segments yellow, the basal enlargements and pectinations dark brown ; first flagellar segment strongly produced beneath but not bipectinate ; flagellar segments two to nine conspicuously bipectinate, the branches shorter on the outer segments ; tenth flagellar segment with a single blunt pectination ; terminal two segments simple, the penultimate with apical glabrous pedicel. Head dark grey.

Pronotum dark. Mesonotal praescutum rich reddish brown, brightest laterally, more pruinose sublaterally and behind, the usual median stripes remaining of the ground-color ; scutum and scutellum pale, more or less light pruinose ; postnotum darker, sparsely pruinose. Pleura largely blackened, the dorso-pleural region paler ; sternopleurite paler, sparsely pruinose. Halteres yellow, the knobs dark brown. Legs with the coxae reddish brown, darker brown at base ; trochanters obscure yellow ; femora obscure brownish yellow, the tips vaguely darker ; tibiae and tarsi dark brown. Wings greyish subhyaline, the costal region indistinctly marked with five or six brown areas, the amount more extensive than the pale interspaces ; remainder of the wing virtually uniformly grey, with very sparse whitish dots in some of the cells ; veins dark brown, the outer costa more yellowish. Venation (Fig. 4*a*) : Sc_1 ending opposite midlength of *Rs*, Sc_2 close to its tip ; a weak supernumerary crossvein in cell *Sc* ; *m-cu* just before the fork of *M*. Macrotrichiae of the veins beyond the cord long and conspicuous.

Abdominal tergites weakly bicolorous, dark brown, the basal portions of the intermediate segments brighter reddish brown ; basal sternites bright reddish brown, the posterior segments with the caudal margins broadly blackened, the subterminal segments entirely so ; male hypopygium dark chestnut-brown. Male hypopygium (Fig. 4*b*) with the mesal face of the basistyle with a long slender lobe tipped with one long and one shorter bristle, and a much shorter and stouter lobe, tipped with a fascicle of about five powerful spinous bristles. Dorsal dististyle long, gently curved, the tip suddenly narrowed into a long straight spike. Ventral dististyle (v) large and fleshy, the elongate rostral prolongation gently curved, relatively slender, provided with three

strong spines near midlength; cephalic margin of rostrum at base with a pencil of four or five long setae. Gonapophyses (g) short and powerful, darkened, the short tip blackened.



TEXT-FIG. 4.—*Rhipidia* (*Rhipidia*) *choprai*, sp. nov.
a. Wing. *b*. ♂ hypopygium.
Symbol: g = gonapophysis; v = ventral dististyle.

Female.—Much like the male but the antennae merely subpectinate. Wings distinctly spotted and dotted with brown and grey. *Sc* ending about opposite or just before midlength of *Rs*.

Hab.—North-west India.

Holotype, ♂, Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, at light (*B. Chopra*).

Allotopotype, ♀, *Paratopotypes*, 6 ♂♂, 7 ♀♀.

This interesting species is named in honor of the collector, Dr. B. N. Chopra, to whom I am indebted for many favors. *R. choprai* is very distinct from the other Oriental members of the subgenus in the nearly immaculate wings of the male and the structure of the hypopygium. The Himalayan Region evidently supports a rich fauna in the genus. The figure given by Brunetti (*Fauna*, pl. xi, fig. 17) of the antenna of the male of *R. antennata* (Brun.) is highly diagrammatic and it is very doubtful that all twelve of the flagellar segments are

bipectinate, as both figured and described. If this is really the case it represents the maximum of pectination in the entire family.

Rhipidia (Rhipidia) tetracantha, sp. nov.

Antennae (♂) with seven bipectinate flagellar segments (flagellar segments two to eight) : segments nine and ten each with a single branch ; general coloration dark grey, the praescutum with a dark brown median stripe ; pleura grey, with two narrow blackish longitudinal stripes ; wings abundantly dotted with grey and with a few larger brown marks in the costal region ; *Sc* ending about opposite one-third the length of *Rs* ; male hypopygium with the rostral prolongation of the ventral dististyle bearing a group of four short spines.

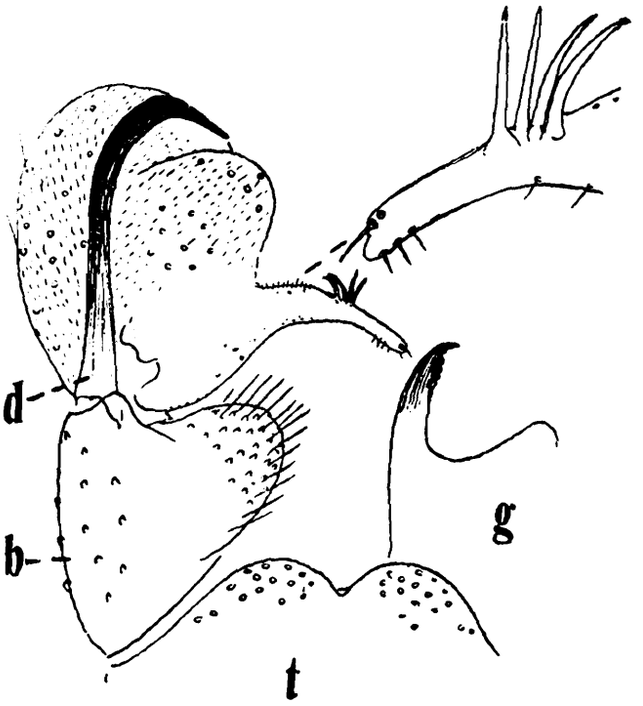
Male.—Length about 5·5 mm. ; wing about 7 mm.

Rostrum and palpi black. Antennae with flagellar segments two to eight bipectinate ; flagellar segments nine and ten each with a single branch, shorter and more slender on segment ten ; flagellar segment eleven enlarged, subglobular at base, with the apical pedicel about one-half as long as the enlargement ; terminal segment elongate, fully one-half longer than the penultimate ; flagellar segments yellow, with the basal enlargements and pectinations brownish black. Head dark grey, the anterior vertex narrow.

Pronotum dark greyish brown. Mesonotal praescutum grey with a conspicuous dark brown median stripe and less evident lateral stripes ; remainder of mesonotum grey, the scutellum and postnotal mediotergite with a capillary blackish median line. Pleura grey with two narrow black longitudinal stripes, the shorter and more ventral stripe along the sternopleurite, the longer dorsal stripe extending from the propleura, beneath the base of the halteres to the abdomen. Halteres pale yellow, the knobs infuscated. Legs with the fore coxae dark basally, yellow apically ; middle and hind coxae obscure yellow ; trochanters yellow ; femora obscure brownish yellow, the middle femora with a vague darker subterminal ring, the tips darker, the fore femora with the tips more uniformly though weakly infuscated ; tibiae brownish yellow, the tips weakly darkened ; tarsi light brown, the tips of segments one and two narrowly darkened ; terminal tarsal segments uniformly darkened. Wings with an abundant grey dotting on a subhyaline ground ; darker brown areas of the same size surround the supernumerary crossvein in cell *Sc*, origin of *Rs*, tip of *Rs* ; veins pale, a little darker where traversed by grey dots. Venation : *Sc* short, Sc_1 ending opposite one-third the length of *Rs*, Sc_2 close to its tip ; *m-cu* just before the fork of *M*.

Abdomen dark brown, the caudal portions of the segments somewhat darker than their bases ; hypopygium obscure yellow. Male hypopygium (Fig. 5) with the basistyle (b) relatively small, the ventro-mesal lobe large, stout. Dorsal dististyle (d) a long slender heavily chitinized rod, the tip suddenly narrowed into a long straight spine. Ventral dististyle large and fleshy, with a second large fleshy lobule at the base of the rostrum ; rostral prolongation large, slender, at near midlength on the outer margin with a group of four short spines, the two more basal a little recurved, the two outer straighter and more erect ; apex

of rostrum tipped with three larger and some additional smaller setae. Gonapophyses (g) large, the caudal mesal lobe directed caudad, nearly straight, the outer margin weakly roughened.



TEXT-FIG. 5.—*Rhipidia* (*Rhipidia*) *tetracantha*, sp. nov. ; ♂ hypopygium.
Symbols : b=basistyle ; d=dorsal dististyle ; g=gonapophysis ; t=9th tergite.

Hab.—North-west India.

Holotype, ♂, Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, in jungle (*B. Chopra*).

I have tried in vain to reconcile this fly with the description of *R.* (*R.*) *subtesselata* (Brun.) of Ceylon, of which *R. zeylanica* S.-W. is a synonym, according to Edwards who has seen the types of both (*Rec. Ind. Mus.*, XXVI, p. 296 ; 1924). Senior-White's figure and description of the male antenna of *zeylanica* indicate that flagellar segments three to eight of the flagellum are bipectinate, only six segments being thus branched. Edwards's observations on the dried and shrivelled antennae of the type of *subtesselata* seemed to indicate that the last bipectinate segment was the seventh flagellar. The essential characters of the male genitalia have been discussed in the species mentioned. *R.* (*R.*) *demarcata* (Brun.) is somewhat similar to *tetracantha* in color but the wings have the dark grey pattern so abundant as to restrict the pale ground-colour to small spots and streaks, two larger ones lying along the costa. In this species, *Sc* ends just before midlength of *Rs*.

Libnotes klossi, sp. nov.

General coloration reddish yellow ; femora brownish black, the distal half or a little less yellow, enclosing a broad subterminal black ring, the apex conspicuously light yellow ; wings pale yellow, handsomely patterned with brown ; ovipositor with the tips of the tergal valves weakly bifid.

Female.—Length about 8 mm. ; wing, 9·3 mm.

Rostrum of moderate length only, about one-half as long as the remainder of the head, dark-colored, the palpi black. Antennae brownish black, the second scapal segment abruptly light yellow. Head buffy yellow, darker behind, the anterior vertex narrow ; the posterior portion of the head of the type is badly shrunken, but appears to be brownish grey laterally.

Pronotum long, dark brown, more yellowish anteriorly. Mesonotum conspicuously reddish brown, the surface of the type discolored ; scutellum paler. Pleura extensively darkened, especially the dorsal and anterior portions. Halteres with the base of the stem yellow, the intermediate portion black ; knobs dark brown with their bases somewhat paler. Legs with the coxae and trochanters reddish brown ; femora brownish black with the distal half or a little less yellow, enclosing a broad conspicuous subterminal black ring (about 1·5 mm.), the apex conspicuously light yellow (about 0·8—0·9 mm.) ; tibiae and tarsi brownish black. Wings with a pale yellow tinge, handsomely patterned with brown ; cells *C* and *Sc* dark brown, the latter more yellowish near outer end ; clearer yellow spots before the stigma and as a clear oval area in the center of the otherwise brown stigmal region ; the brown pattern is arranged as follows : An area in the base of cell *R* ; broad conspicuous seams along *Rs* and the remainder of the cord, the seam of the former continued outward along vein R_{2+3} for a distance and then traversing cell R_1 to the end of vein Sc_1, forming a Y-shaped figure ; another Y-shaped cloud at the stigma, the stem on the basal section of R_2 (*r* of earlier workers), one arm extending basad on R_1, the other distad along the free distal section of R_1 and R_2, the fork of this cloud enclosing the yellow oval mentioned before ; conspicuous brown clouds on the outer end of cell *1st* M_2 and at the ends of all the veins, forming extensive marginal clouds in all the cells ; a subapical brown fascia ; veins yellow, dark brown in the infuscated areas. Venation : Sc_1 relatively long, ending near midlength of R_{2+3}, Sc_2 some distance from its tip, Sc_1 alone being longer than *m-cu* ; *Rs* relatively short and straight, more arcuated near its outer end and thus resembling *Limonia* ; veins beyond the cord all greatly elongated, as in *Libnotes* ; basal section of R_2 about two-thirds the length of the distal section of R_1 and R_2 (in earlier papers considered as being the distal section of R_1 alone) ; cell *1st* M_2 very elongate, the outer end gently widened, *m-cu* at mid-length and about two-thirds the distal section of Cu_1 ; *m* arcuated to weakly angulated, the outer deflection of M_3 much shorter, straight ; cell *1st* M_2 longer than M_3 beyond it but shorter than M_{1+2} ; cell *2nd A* large.

Abdominal tergites dark reddish brown, the caudal margins of the intermediate segments paler ; sternites a little paler ; genital segment dark. Ovipositor with the tergal valves relatively long, gently curved, the tips weakly notched, the apices thus formed unequal ; sternal valves straight, the tips acute pointed.

Hab.—Federated Malay States.

Holotype, ♀, Ginting Bidai, altitude 2,000 feet, Selangor-Pahang Boundary, April 1917 (*C. Boden-Kloss*).

This beautiful crane-fly is named in honor of the collector. *Libnotes klossi* is another species of the genus that curiously approaches *Limonia* in several respects but in the chief features of venation (the nearly straight *Rs*; elongation of the veins beyond the cord) agrees better with *Libnotes* than with *Limonia*. The nearest relative known to me is *L. terrae-reginae* Alex. (S. Queensland—N. New South Wales) which has *Rs* much longer and more arcuated, thus being even more like *Limonia*, and with cell *1st* M_2 shorter.

Limonia palniensis, sp. nov.

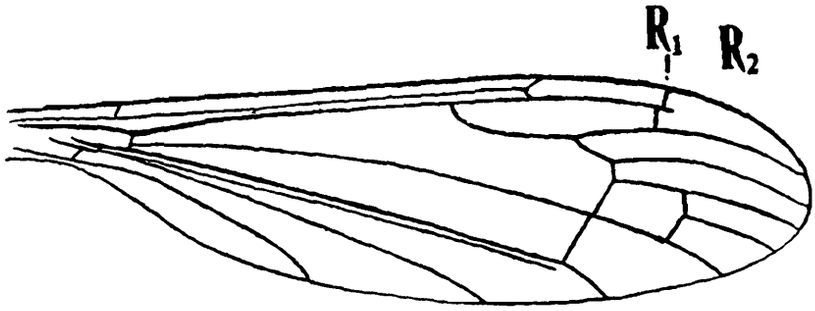
Anterior vertex broad, silvery; remainder of head black; antennae brownish black throughout; mesonotum chestnut-brown, blackened posteriorly; legs brownish black, the posterior tarsi extensively light yellow; wings tinged with brown, the oval stigma darker brown; cell *1st* M_2 large, subquadrate; *m-cu* at the fork of *M*; abdominal tergites black, the caudal margins of the segments broadly silvery; sternites largely yellow.

Female.—Length about 5·5 mm.; wing, 6·6 mm.

Rostrum shiny chestnut, the palpi brownish black. Antennae brownish black throughout, the basal flagellar segments oval, with short apical pedicels, the outer segments becoming more elongate oval, the terminal segment about one-third longer than the penultimate; flagellum with a unilaterally arranged series of longer verticils, one to each segment, in addition to the other smaller setae. Anterior vertex silvery-white, the posterior part of the head black; anterior vertex wide, approximately four times as wide as the diameter of the first scapal segment.

Pronotum relatively small, black. Mesonotal praescutum high, gibbous, more chestnut-brown in front, blackened behind, the humeral region yellowish, the median region in front with a black spot that represents the cephalic end of the usual median stripe, these stripes behind entirely confluent; scutum obscure yellowish testaceous, the lobes largely darkened; anterior mesonotum, including the region of the praescutal stripes and the scutal lobes, with abundant microscopic roughenings that produce a dense reticulated or tesselated effect; scutellum brownish testaceous, shiny; postnotal mediotergite obscure yellow, each cephalic lateral angle extensively blackened. Pleura brownish chestnut, the propleura veriegated with black, the details of coloration not readily distinguishable in the material on hand. Halteres of moderate length, dark brown. Legs with the coxae and trochanters brownish yellow; femora brownish yellow basally, soon passing into brownish black; tibiae and tarsi brownish black; posterior tarsi with the extreme tip of the basitarsus and all of segments two to four light yellow; terminal segment dark brown. Wings with a strong brown suffusion, the small oval stigma darker brown; a vague seam along vein Cu_1 and a scarcely perceptible darkening along the cord brown; veins dark brown. Venation (Fig. 6): *Sc* of moderate length, Sc_1 ending about opposite two-thirds *Rs*, Sc_2 at its tip; *Rs* arcuated to weakly angulated at origin; basal section of R_2 lying immediately basad of the distal section of R_1, the distal section of R_2 being represented by a short spur that is provided with four or five macrotrichiae; cell

1st M_2 large, subquadrate ; *m-cu* at the fork of *M*, about equal to the distal section of Cu_1.



TEXT-FIG. 6.—*Limonia palniensis*, sp. nov. ; wing.
Symbol : R=Radius.

Abdominal tergites black, the caudal margins of segments two to seven broadly and conspicuously pale, more or less silvery ; sternites largely yellowish ; genital segment black, the valves of the ovipositor reddish horn-color, the tergal valves slender, only gently upcurved.

Hab.—South India.

Holotype, ♀, Kodaikanal, Palni Hills, altitude 6,900—7,200 feet, September 1922 (*S. W Kemp*).

Paratopotype, ♀, altitude 6,700—7,000 feet, August 1922 (*S. W Kemp*).

Limonia palniensis is very closely allied to *L. flavocincta* (Brun.) of Western India, but I cannot reconcile the descriptions of the two. In the present species there is no trace of yellow on the middle tarsi, as described by Edwards (*Rec. Ind. Mus.*, XXVI, p. 298 ; 1924). The venation and coloration of the wings is very similar in both species but the thoracic pattern is very different from Brunetti's description. Neither Brunetti nor Edwards mention the beautiful silvery white anterior vertex in their observations on *L. flavocincta*.

Geranomyia (Geranomyia) poliophara, sp. nov.

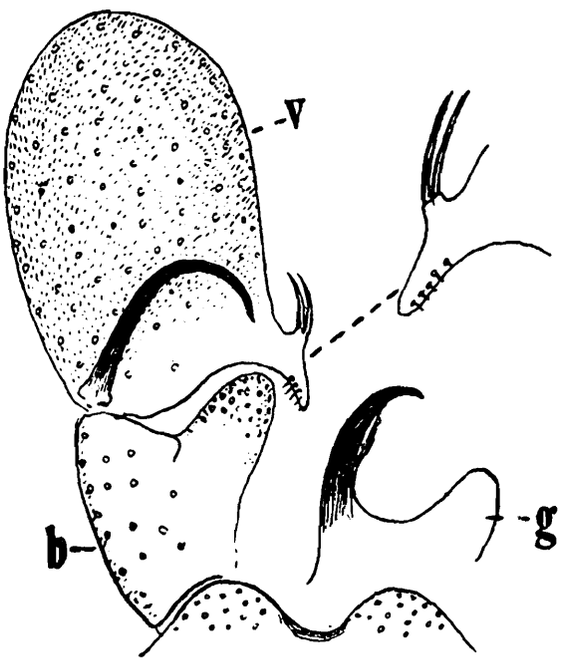
General coloration light grey, the praescutum with three brownish black stripes ; femora with a brownish black subterminal ring ; wings whitish subhyaline with a heavy brown pattern, chiefly distributed in the costal region ; *Sc* relatively short, ending about opposite one-third to two-fifths the length of *Rs*.

Male.—Length (excluding rostrum) about 5 mm. ; wing, 6·5 mm. ; rostrum alone, about 2·6 mm.

Rostrum elongate, black throughout, the palpi concolorous. Antennae brownish black throughout. Head dark brownish grey behind, the anterior vertex apparently clearer grey but this region deformed by shrinkage.

Mesonotal praescutum light grey with three brownish black stripes, the median stripe more diffuse, broadest in front, becoming paler and more attenuated to broken behind ; lateral stripes unusually long and narrow, prolonged cephalad before the level of the pseudosutural foveae and here slightly more reddish brown, diverging gently from the median stripe ; scutum pale medially, the lobes grey, with a darker semicircular marking ; extreme postero-medial region of praescutum, median region

of scutum and the scutellum reddish brown ; postnotum dark grey, the mediotergite with a weakly impressed median furrow and broken transverse ridges on the basal half of the sclerite, possibly not normal. Pleura dark brownish grey, the sternopleurite and pteropleurite variegated with paler. Halteres entirely light yellow. Legs with the coxae obscure yellow, the middle coxae more infuscated basally ; trochanters obscure yellow ; femora brown, the bases narrowly more yellowish ; a narrow brownish black subterminal ring, the extreme apices narrowly reddish brown ; tibiae yellowish brown, the tips conspicuously blackened ; tarsi dark brown, the bases of segments one and two paler. Wings whitish subhyaline, the base and interspaces of the subcostal cell bright yellow ; a heavy chiefly costal dark brown pattern, distributed as follows : A large stigmal area ; an elongate area at origin of *Rs*, extending from costa almost to *M* ; a small area at tip of *Sc*, so close to the last as to be practically confluent along the costa, narrowly separated behind, the area not quite reaching *Rs* ; a large area surrounding the supernumerary crossvein in cell *Sc*, this scarcely reaching *M* ; the most basal area occupies cells *C* and *Sc* immediately beyond *h*, scarcely invading cell *R* ; a large spot at tip of vein R_3 and another in cell R_3 immediately behind *r* ; a small cloud at end of R_{4+5} ; narrow but very conspicuous brown seams along the cord and outer end of cell *1st* M_2 ; extensive but very vague pale brown washes at ends of the anal veins ; veins dark brown, yellow in the costal interspaces. Venation : *Sc* relatively short, ending about opposite one-third to two-fifths the length of *Rs*, Sc_2 at the tip of Sc_1 ; a supernumerary crossvein near midlength of cell *Sc* ; *Rs* angulated and weakly spurred at origin ; cell *1st* M_2 elongate, exceeding any vein beyond it ; *m-cu* shortly before the fork of *M*.



TEXT-FIG. 7.—*Geranomyia poliophara*, sp. nov. ; ♂ hypopygium.
Symbols : b=basistyle ; g=gonapophysis ; v=ventral dististyle.

Abdominal tergites dark brown, the caudal margins more or less light yellow. Male hypopygium (Fig. 7) with the ninth tergite deeply emarginate medially, the lateral lobes prominent, setiferous, the median

emargination glabrous, feebly chitinized. Basistyle (b) relatively small, the ventro-mesal lobe relatively stout, with long conspicuous setae. Dorsal dististyle a strong curved sickle-shaped hook, the tip acute. Ventral dististyle (v) large and fleshy, the rostal prolongation small, yellow, with two relatively short spines situated on a common papilla, the spines subequal, directed strongly basad. Gonapophyses (g) conspicuous, the mesal apical angle produced into a conspicuous blackened lobe. Aedeagus relatively small.

Hab.—North-west India.

Holotype, ♂, Simla, Western Himalayas, Station 1, altitude 6000—7000 feet, August-September 1925, in jungle (*B. Chopra*).

Geranomyia poliophara is distinct from any of the numerous spotted winged species of the genus in the combination of characters given above.

Dicranomyia (Thrypticomyia) monocera, sp. nov.

Thorax uniformly reddish brown; basitarsi with proximal ends darkened; wings subhyaline, the stigma small, the wing-tip very vaguely darker; male hypopygium with a single elongate spine on the rostral prolongation of the ventral dististyle.

Male.—Length about 4·5 mm.; wing, 5·5 mm.

Rostrum and palpi dark brown. Antennae dark brown; flagellar segments as in the subgenus, short-petiolate, with elongate, unilaterally arranged verticils. Head dark.

Thorax uniformly reddish brown. Halteres elongate, brown, including the knobs. Legs with the coxae and trochanters reddish brown; femora and tibiae dark brown; tarsi white, the basitarsi darkened at proximal ends, on the posterior basitarsi including a little less than the basal third, on the middle basitarsi a little more extensive, including approximately the basal two-fifths; fore legs broken. Wings subhyaline, the stigma small, oval, dark brown; wing-tip very vaguely and insensibly darker than the remainder of the wing; veins dark. Venation: Sc_1 ending only a short distance before the origin of *Rs*, Sc_2 not far from its tip; *r* elongate, a little exceeding *m-cu*; distal spur of R_2 short, about one-half the basal section; inner end of cell *1st* M_2 moderately arcuated; *m-cu* at midlength of cell *1st* M_2.

Abdomen brownish black, the sternites a little paler, especially the basal segments. Male hypopygium with the rostral prolongation of the ventral dististyle short and stout, with a single very long, powerful spine that is nearly twice as long as the rostrum itself, the spine arising from an elevated papilla.

Hab.—Java.

Holotype, ♂, Buitenzorg, March 1909 (*Bryant* and *Palmer*).

Type in my own collection.

Dicranomyia abjuncta, sp. nov.

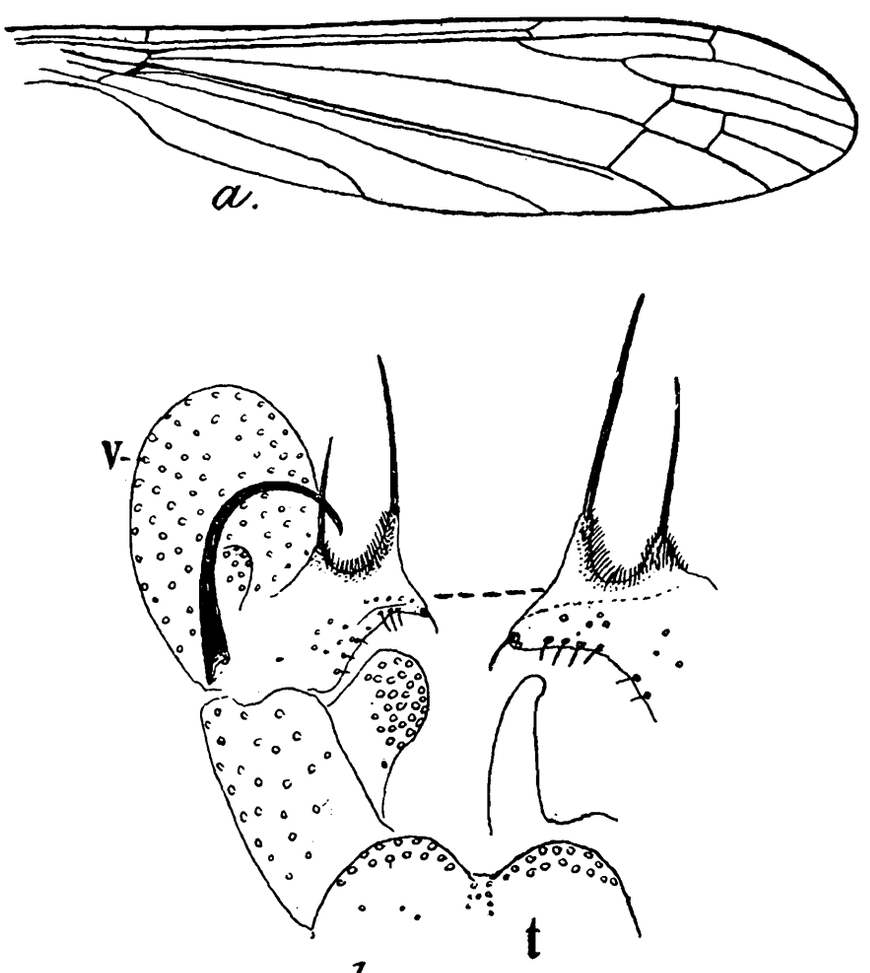
General coloration dark; antennae dark brown throughout, the flagellar segments with very long verticils; wings with a strong brown suffusion, the long oval stigma darkar; *Sc* relatively long, both *Sc*

and Sc_2 ending shortly beyond the origin of *Rs* ; male hypopygium with the rostral prolongation of the ventral dististyle with two very long widely separated spines that arise from swollen bases.

Male.—Length about 7 mm. ; wing, 8·3 mm.

Rostrum and palpi dark brown. Antennae relatively long, dark brown throughout, the flagellar segments elongate with long conspicuous verticils that exceed in length the segments bearing them. Head brown, the vertex of moderate width.

Mesonotum badly discolored in the unique type and the coloration is discussed in general terms only ; the entire notum seems to be brown rather than grey, the pleura likewise dark-colored. Halteres relatively short, yellow, the knobs dark brown. Legs with the fore coxae dark, concolorous with the pleura ; middle coxae with only the basal half darkened, the hind coxae pale ; trochanters obscure yellow ; legs long and slender ; femora brown, their bases more yellowish, the tips broadly darker brown ; tibiae and tarsi dark brown. Wings with a strong brown suffusion, the long oval stigma darker brown ; veins still darker brown. Venation (Fig. 8*a*) : Sc_1 ending distinctly beyond the origin



TEXT-FIG. 8.—*Dicranomyia abjuncta*, sp. nov.
a. Wing. *b*. ♂ hypopygium.
Symbols : t=9th tergite ; v=ventral dististyle.

of *Rs*, about opposite one-fifth to one-sixth the length of the latter, Sc_2 not far from its tip and likewise beyond the origin of *Rs* ; tip of

R_1 just basad of the level of the basal section of R_2, r thus being preserved as a short setiferous element; *Rs* long, about twice the basal section of R_{4+5}; cell *1st* M_2 relatively large, subquadrate, subequal to or a little shorter than vein M_4 beyond it; *m-cu* near the fork of *M*, about equal to the distal section of Cu_1.

Abdominal tergites dark brown or brownish black, the basal sternites more bicolorous; hypopygium brown. Male hypopygium (Fig. 8*b*) with the ninth tergite (t) rather deeply emarginate, each lobe with numerous setae and with a few smaller median setae in the emargination. Basistyle relatively small, the ventro-mesal lobe large and conspicuous. Dorsal dististyle a very strongly arcuated, sickle-shaped, slender rod, the tip acute. Ventral dististyle (v) large and fleshy, much larger than the basistyle, with a small lateral lobule before the rostral prolongation; the latter is large and broad, with two very elongate, widely-separated spines, the outer spine longer and stouter than the other, arising from an elongate swollen base, placed shortly before the apex of the prolongation; the inner spine arises from a smaller swollen base, which, together with the adjoining face of the base of the outer spine, as well as the entire intervening space, is densely set with short erect setae. Gonapophyses (g) with the meso-caudal angle long and conspicuous.

Hab.—India.

Holotype, ♂, Sureil, Mangpu, Darjiling District, Eastern Himalayas, altitude 5,000 feet, April-May 1917 (*S. W Kemp*).

Dicranomyia abjuncta appears to come closest to the description of *D. fortis* Brunetti, which, however, differs in the coloration of the body, legs and wings.

Dicranomyia (Dicranomyia) synclera, sp. nov.

General coloration pale fulvous yellow; antennae with the basal segments pale; halteres relatively short, the knobs darkened; wings pale yellowish subhyaline, entirely unmarked; Sc_1 ending shortly beyond the origin of *Rs*; male hypopygium with the rostral prolongation of the ventral dististyle entirely blackened, bearing two long slender spines at base.

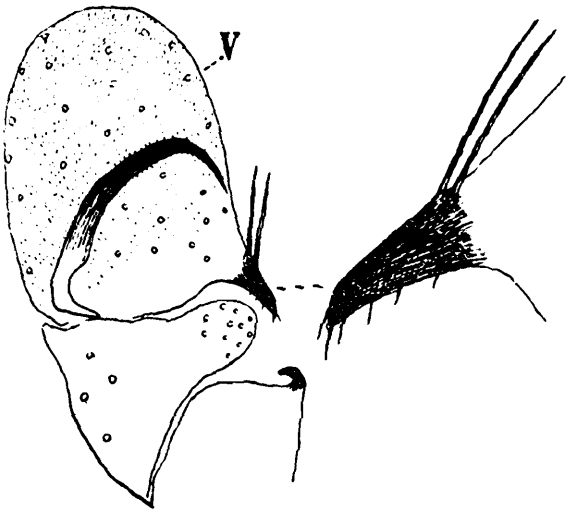
Male.—Length about 4·8 mm.; wing, 6—6·2 mm.

Female.—Length about 5 mm.; wing about 6 mm.

Rostrum and palpi pale yellow. Antennae with the basal segments, including the scape and basal three or four segments of the flagellum, pale, the outer segments more infuscated; antennae small, the basal flagellar segments subglobular, crowded, the outer segments more oval. Head whitish yellow, the black eyes contrasting strongly; anterior vertex nearly twice as wide as the diameter of the first scapal segment.

Mesonotum uniformly fulvous yellow, subnitidous, the pleura of approximately the same color. Halteres relatively short, pale yellow, the knobs darkened. Legs with the coxae and trochanters concolorous with the pleura; femora and tibiae yellow, the tips narrowly darkened; tarsi brownish yellow, the terminal segments passing into black. Wings pale yellowish subhyaline, entirely unmarked; veins pale brown. Venation: Sc_1 ending shortly beyond the origin of *Rs*, Sc_2 a corresponding distance before the origin, though these positions vary slightly in a

series ; Sc_1 alone is about twice the basal section of R_2 ; *Rs* of moderate length, gently arcuated, approximately twice the basal section of R_{4+5} ; cell *1st* M_2 relatively large, a little longer than vein M_3 beyond it, the inner end slightly arcuated, lying far proximad of cell R_5 ; *m-cu* close to the fork of *M*. Macrotrichiae on *Rs* and the longitudinal veins beyond the cord ; basad of the cord on the distal end of *M* and the basal section of Cu_1 ; none on *1st A* ; a few on the distal quarter of *2nd A*.



TEXT-FIG. 9.—*Dicranomyia synclera*, sp. nov. ; ♂ hypopygium.
Symbol : v = ventral dististyle.

Abdomen brownish yellow. Male hypopygium (Fig. 9) with the basistyle short, the ventro-mesal lobe of moderate size. Dorsal dististyle elongate, narrow, the apex long, slender, acutely pointed. Ventral dististyle (v) moderately large and fleshy, the rostral prolongation heavily blackened throughout, at the base on the outer margin with two long, slender, subequal spines, arising from short swollen bases, these spines erect or bent slightly backwards, longer than the rostrum beyond them. Gonapophyses appearing as very broad flattened blades, the apical mesal lobe very small, blackened, forming a small stout hook. Ovipositor with the tergal valves relatively short, very slender, gently upcurved to the acute tips ; sternal valves short and stout.

Hab.—North-west India.

Holotype, ♂, Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, at light (*B. Chopra*).

D. synclera agrees best with *D. flavobrunnea* Brun. and *D. simplex* Brun., of Bengal, but is distinct in the details of coloration. The structure of the male hypopygium is distinctive.

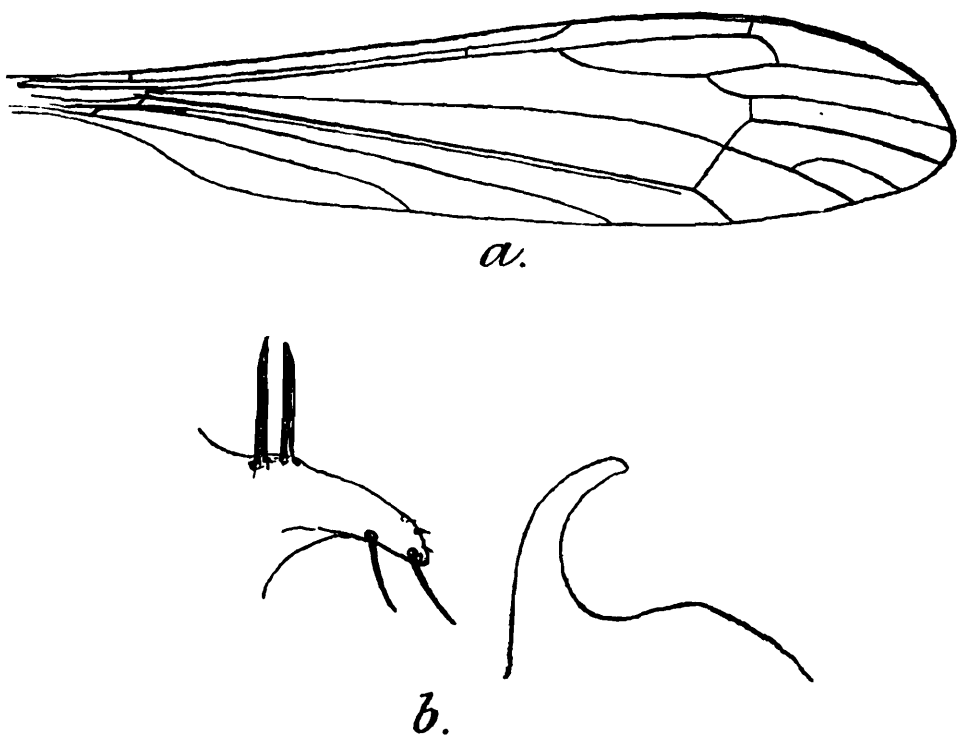
Dicranomyia innocua, sp. nov.

General coloration of the head grey ; mesonotum very high and gibbous, brown, darkest medially ; halteres yellow, the knobs infuscated ; wings with a pale brown suffusion, the oval stigma a little darker ; *Sc* ending about opposite the origin of *Rs*, Sc_1 long ; cell M_2 open by the atrophy of *m*.

Male.—Length about 4·6 mm. ; wing, 6·1 mm.

Rostrum light yellowish brown ; palpi brownish black. Antennae black, the basal segments a trifle paler ; flagellar segments oval, becoming more slender and elongate distally, the last segment one-half longer than the penultimate ; flagellar verticils relatively short and inconspicuous, not exceeding the segments in length. Head largely light grey, the vertex apparently with a darker marking ; anterior vertex relatively wide.

Pronotum dark brown medially, obscure yellow laterally. Mesonotum very high and gibbous, dull brown, darkest medially, the humeral and lateral regions brighter, the dark coloration produced by the confluent praescutal stripes ; scutum pale medially, the lobes dark brown ; scutellum dark with a pale median spot ; postnotum dark, sparsely pruinose. Pleura reddish brown on the propleura and anepisternum, the remainder of the pleura and the pleurotergite conspicuously light grey pruinose. Halteres yellow, the knobs infuscated. Legs with the coxae brown, the middle and hind coxae sparsely pruinose ; trochanters reddish yellow ; legs long and slender, pale brown, the terminal tarsal segments dark brown. Wings with a pale brown suffusion, the oval stigma slightly darker brown ; veins pale brown. Venation (Fig. 10*a*) : *Sc* short, Sc_1 ending just beyond the origin of *Rs*, Sc_2 far removed from the tip of Sc_1, the latter alone approximately two-thirds the length of *Rs* ; tip of R_1 very faint but preserved, lying proximad of the basal section of R_2, *r* being present, setiferous ; cell M_2 open by the atrophy of *m* ; cell M_3 longer than its petiole ; *m-cu* at the fork of *M*, subequal to the distal section of Cu_1 ; vein *2nd A* relatively long.



Text-fig. 10.—*Dicranomyia innocua*, sp. nov.
a. wing. *b*. ♂ hypopygium, details.

Abdominal tergites dark brown, the sternites brighter. Male hypopygium with the basistyles relatively small, the ventro-mesal lobe relatively elongate, setiferous. Dorsal dististyle a long, strongly curved

sickle-shaped hook, relatively slender, the tip suddenly narrowed to an acute point. Ventral dististyle large and fleshy, the rostal prolongation (Fig. 10*b*) relatively small and inconspicuous, with two subequal spines of moderate length not far from the base; these spines are placed close together, not on elevated bases, their tips acute; apex of the prolongation beyond the spines longer than the length of a single spine; provided with one or two powerful setae close to the apex and a similar seta at near midlength of the lower face of the prolongation; a few additional much smaller setae.

Hab.—Assam.

Holotype, ♂, Shillong, Khasi Hills, altitude 5,500—6,400 feet, August 29—September 5, 1915 (*S. W Kemp*).

Dicranomyia innocua is allied to *D. absens* Brun., differing in the details of thoracic coloration and the venation.

Dicranomyia goana, sp. nov.

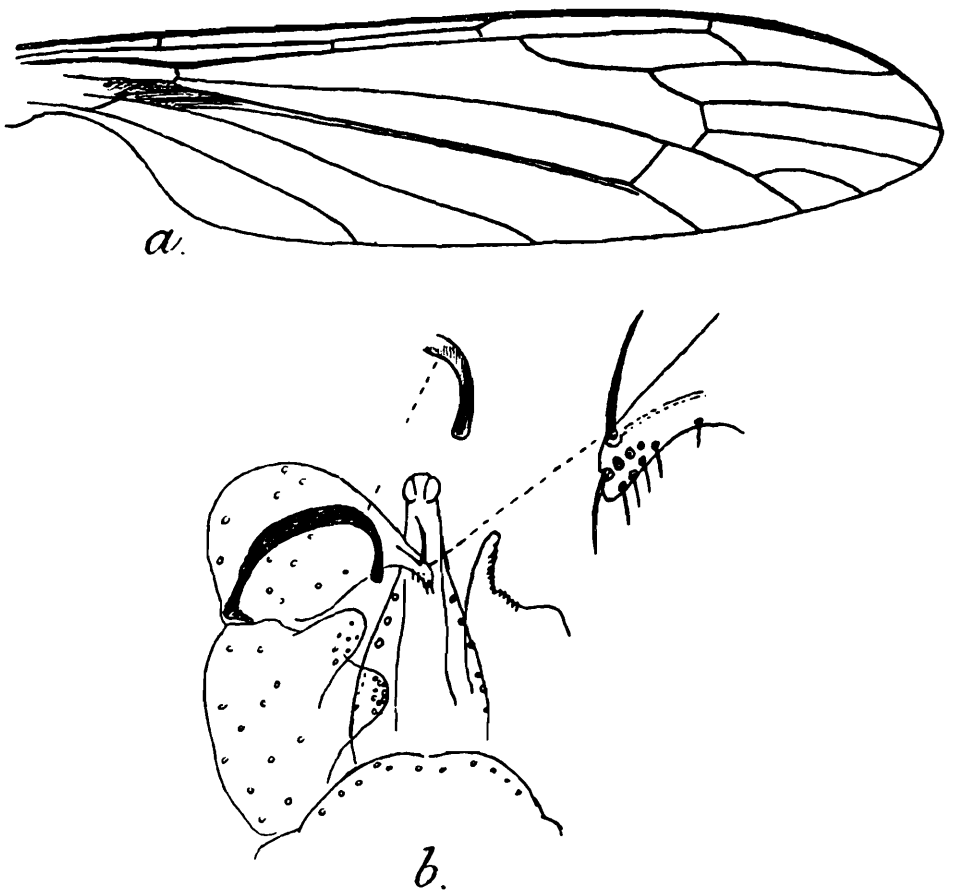
General coloration grey, the praescutum with three reddish brown stripes; pleura with a conspicuous black longitudinal stripe; wings pale brownish yellow; *Sc* short; a supernumerary crossvein in cell *Sc*; cell M_2 open by the atrophy of *m*; male hypopygium with the dorsal dististyle obtuse at apex.

Male.—Length about 4·5 mm.; wing, 5·2 mm.

Rostrum and palpi dark. Antennae short, uniformly pale; flagellar segments subglobular, gradually decreasing in size outwardly, the last two more oval; verticils very stout and bristle-like, approaching the subspinous verticils of the subgenus *Idioglochina*. Head light fawn-brown, paler anteriorly; vertex relatively narrow.

Mesonotal praescutum light grey with three conspicuous reddish brown stripes, the median stripe broadest in front, narrowed behind, very vaguely divided medially by a paler capillary vitta; scutum pale medially, the lobes dark brown; scutellum brown, with a narrow median pale line; postnotum dark reddish brown, sparsely pruinose. Pleura reddish brown with a relatively narrow but conspicuous black longitudinal stripe extending from the cervical sclerites, passing beneath the root of the halteres, to the abdomen. Halteres short, pale, the knobs weakly infuscated. Legs with the coxae and trochanters reddish brown; remainder of legs obscure yellow, the terminal tarsal segments dark brown. Wings with a pale brownish yellow tinge, the prearcular region darker, the costal region clearer yellow; very small and vague brown spots, the most evident at the origin of *Rs*; veins brown, the incrassated costa, with *Sc* and *R*, more yellowish. Venation (Fig. 11*a*): Costa between the tip of Sc_1, and R_3 strongly incrassated; *Sc* short, Sc_1 ending shortly before the origin of *Rs*, Sc_2 close to its tip; a supernumerary crossvein in cell *Sc* at near mid-distance between arculus and the origin of *Rs*; tip of R_1 distinctly preserved; *r* in alignment with the basal section of R_2, the distal section entirely atrophied; cell M_2 open by the atrophy of *m*; cell M_3 relatively short, M_4 being shorter than M_{3+4}; *m-cu* a short distance before the fork of *M*, shorter than the distal section of Cu_1; cell *2nd A* wide, the anal angle of the wing being well-developed.

Abdomen brownish black, the caudal margins of the segments paler; basal sternites obscure brownish yellow, the remaining sternites brownish



TEXT-FIG. 11.—*Dicranomyia goana*, sp. nov.
a. wing. *b*. ♂ hypopygium.

black; hypopygium paler. Male hypopygium (Fig. 11*b*): Ninth tergite only gently emarginate medially, the caudal margin with a sparse row of setae. Basistyle relatively large, the ventro-mesal lobe large, obtuse; an additional mesal lobe that is still larger, more obtuse and tipped with more abundant setae. Dorsal dististyle strongly curved, widest near midlength, the apex obtuse. Ventral dististyle relatively small, a little broader than long, the rostral prolongation apparently bearing a single spine, with a weak line or furrow extending away from the base of the spine; several additional setae on the prolongation. Gonapophyses large, the mesal apical lobe small, the outer margin crenulate. Aedeagus large, subtended on either side by broad wings that bear large marginal setae.

Hab.—Portuguese India.

Holotype, ♂, Mormugao, Goa, September 1916 (*S. W Kemp*).

Dicranomyia goana would seem to be a generalized and scarcely modified member of the subgenus *Idioglochina*. The fly was mentioned briefly by Brunetti (*Rec. Ind. Mus.*, XV, p. 286).

Orimargula gracilipes, sp. nov.

Legs and antennae long and slender; mesonotal praescutum brownish black, the lateral margins broadly reddish; pleura blackened; legs entirely yellow; wings relatively narrow; *m-cu* far from the tip of Cu_1.

Female.—Length about 5 mm. ; wing about 4·8 mm. ; hind leg, femur, 5 mm. ; tibia, 5·5 mm. ; basitarsus, 4·5 mm. ; remainder of tarsus, 1·4 mm.

Rostrum light brown, the palpi dark brown. Antennae elongate, filiform, in the male sex presumably elongate as in *O. gracilicornis* Edw. and *O. longicornis* Alex. ; dark brown throughout, the segments elongate-cylindrical. Head dark.

Mesonotal praescutum brownish black, the lateral margins broadly reddish ; scutum light yellowish brown, the lobes dark brown ; scutellum dark brown, margined caudally with paler ; postnotum reddish brown. Pleura blackened. Halteres light yellow, the knobs infuscated. Legs with the coxae discolored, apparently concolorous with the pleura ; remainder of legs yellow, including the tarsi. Legs very long and slender, as shown by the measurements, the tibiae exceeding the femora, the tarsi similarly exceeding the tibiae. Wings relatively narrow, light grey, the stigma not indicated ; veins relatively pale brown. Venation : *Sc* ending about opposite five-sixths the length of the relatively short, straight *Rs* ; basal section of R_2 a little shorter than R_{2+3} ; *r-m* destroyed in both wings of the type but placed far out on R_{4+5}, the basal section of the latter at least three times *m-cu* ; cell M_3 approximately twice its petiole, the latter about equal to *m-cu* ; *m-cu* nearly twice its length before the fork of *M*, about one-third as long as the distal section of Cu_1.

Abdomen dark brown, the caudal margins of the segments narrowly paler ; genital segment slightly pruinose. Ovipositor with the long slender valves horn-colored, the tergal valves gently upcurved.

Hab.—South-west India.

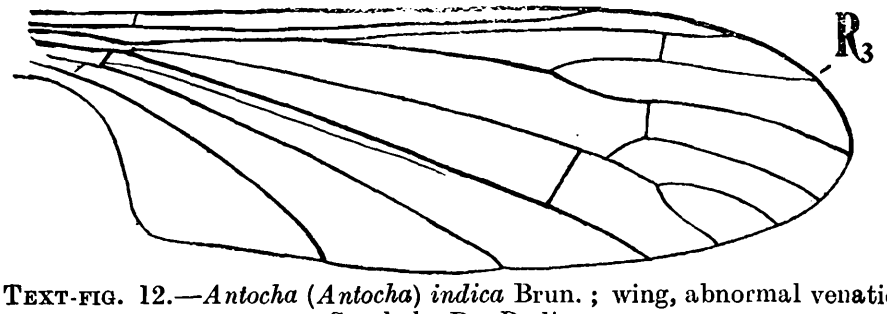
Holotype, ♀, Castle Rock, N. Kanara District, October 11—26, 1916 (*S. W Kemp*).

Orimargula gracilipes is most closely allied to *O. gracilicornis* Edw. (Sumatra), from which it is distinguished by the diagnostic features above listed. The type is not in good condition, the wings being badly matted and broken. The genus *Orimargula* is new to the fauna of British India.

Antocha indica Brun.

(Plate XIII, fig. 4.)

A male, from Almora, Kumaon, altitude 5,500 feet, June 16 1911 (*C. Paiva*) has cell *1st* M_2 open by the atrophy of *m* (Fig. 12), thus pro-



TEXT-FIG. 12.—*Antocha* (*Antocha*) *indica* Brun. ; wing, abnormal venation. Symbol : R=Radius.

ducing the venation of an *Orimargula*. There can be no question of the specific identity.

Orimarga horai, sp. nov.

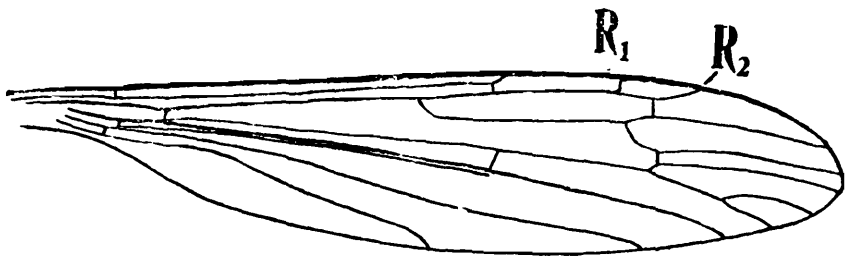
(Plate XIII, fig. 5.)

General coloration pale brown, the mesonotum unmarked ; antennal flagellum dark brown ; legs pale, almost whitish, only the terminal tarsal segments darker ; wings greyish, the axillary region a little darker ; *Sc* relatively short, Sc_1 ending opposite two-fifths the length of *Rs*, opposite *m-cu* ; *Rs* longer than R_3.

Female.—Length about 6·5 mm. ; wing, 5·4 mm.

Rostrum pale yellow, the palpi brown. Antennae with the scapal segments yellowish brown, the flagellum dark brown ; flagellar segments short-oval, gradually decreasing in size outwardly, the last the smallest. Head grey.

Mesonotum uniformly pale brown. Pleura pale brown, the ventral pleurites paler. Halteres light yellow, the knobs infuscated. Legs with the coxae and trochanters reddish yellow, the fore coxae a little darker ; femora whitish, the tips very little darker ; tibiae whitish, the tips not darkened ; tarsi similar, the third and succeeding segments brown. Wings greyish, the axillary region a little darker ; veins pale brown. Venation (Fig. 13) : Sc_2 more than its own length from the tip of Sc_1, the latter ending about opposite two-fifths the length of the long *Rs* ; tip of R_1 distinctly preserved ; *r* in direct alignment with the penultimate section of R_1 and the distal section of R_2, the latter about twice the basal section of R_2 ; *Rs* long, exceeding R_3 ; basal section of R_2 about one and one-half times its length beyond the fork of *Rs* ; basal section of R_{4+5} relatively short, weakly angulated near midlength ; M_{3+4} about equal to M_3 and about one-third longer than M_4 ; *m-cu* about opposite Sc_2 and below two-fifths the length of *Rs* ; Cu_2 ending opposite *m-cu* ; vein *2nd A* ending before *m-cu*. Macrotrichiae on R_3 relatively sparse, about 13 in number, crowded outwardly, confined to the distal half of the vein ; two macrotrichiae on the outer half of the angulated basal section of R_{4+5}.



TEXT-FIG. 13.—*Orimarga horai*, sp. nov. ; wing.
Symbol : R=Radius.

Abdomen dark brown, the basal sternites paler ; genital segment obscure brownish yellow. Ovipositor with the small tergal valves slender, gently upcurved to the acute tips, the long sternal valves straight.

Hab.—North-west India.

Holotype, ♀, Kollar Kahar, Salt Range, Punjab, July 1922 (*S. L. Hora*).

The species is named in honor of Dr. S. L. Hora, Assistant Superintendent in the Zoological Survey of India, who collected the type.

O. horai is most closely allied to *O. peregrina* Brun., of the Eastern Himalayas, and *O. asignata* S.-W., of Ceylon. Senior-White states that his *asignata* agrees exactly in venation with Brunetti's description (but not his figure) of *peregrina*. This being so, the present species differs from both in the venation, especially the short *Sc*, the unusually long *Rs*, short cell M_3 and other details. The venation of *peregrina* as figured by Brunetti (*Fauna*, pl. viii, fig. 11) is faulty in the length of *Sc*, which is shown as ending where the distal section of R_1 should be. This mistake was later corrected by Brunetti (*Rec. Ind. Mus.*, XV, p. 309 ; 1918).

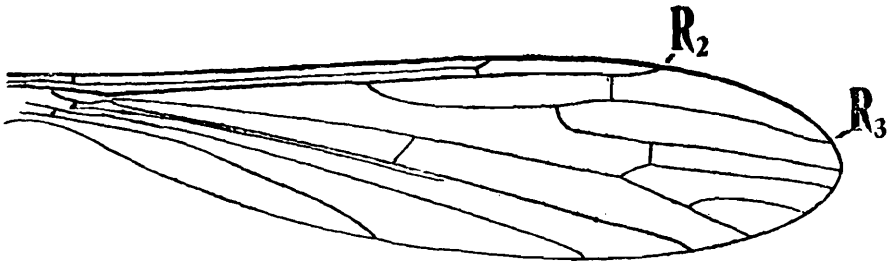
Orimarga annandalei, sp. nov.

1918. *Orimarga peregrina* Brun., *Rec. Ind. Mus.*, XV, p. 309 ; *nec O. peregrina* Brun., *Fauna Brit. India, Nematocera*, p. 424 ; 1912.

Female.—Length about 4·2 mm. ; wing, 4 mm.

Rostrum reddish brown, palpi dark. Antennae uniformly brownish black ; flagellar segments subglobular to short-oval. Head dark grey.

Mesonotum relatively dark brown, without distinct markings. Pleura apparently dark-colored, but not clearly evident, due to the pinning. Halteres pale, the knobs darker. Legs chiefly dark brown, the femoral bases narrowly yellowish. Wings with a strong greyish tinge, the veins brown. Venation (Fig. 14) : Sc_1 ending about opposite three-fifths the length of *Rs*, Sc_2 a little more than its own length from the tip of Sc_1, both lying far beyond *m-cu* ; tip of R_1 not evident ; *Rs*



TEXT-FIG. 14.—*Orimarga annandalei*, sp. nov. ; wing.
Symbol : R=Radius.

relatively long but shorter than R_3, gently arcuated at origin ; distal section of R_2 about one-half longer than the basal section (*r* of previous papers), the latter a little less than twice R_{2+3} ; basal section of R_{4+5} elongate, strongly arcuated at origin, the straight apical portion being longer than the petiole of cell M_3 ; *r-m* lying opposite the tip of R_2 ; M_{3+4} a trifle longer than M_4 and about three-fifths of M_3 ; *m-cu* at about one-fourth the length of *Rs*, oblique in position ; vein *2nd A* ending opposite the posterior end of *m-cu* and just beyond the origin of *Rs*. Macrotrichiae relatively sparse ; none on the distal section of R_2 ; on R_3 only about 9, well scattered along the length basad to opposite the tip of the distal section of R_2.

Abdomen dark reddish brown. Ovipositor with the tergal valves very small, the sternal valves much exceeding the tergal valves, straight and powerful.

Hab.—Perak.

Holotype, ♂, Hills near Taiping, December 26—30, 1915 (*N. Annandale*).

Allotopotype, ♀. *Paratopotype*, ♂. The type and paratype are in the Indian Museum, the allotype in my collection.

As indicated above, *O. annandalei*, which is dedicated to the memory of the late Director of the Zoological Survey of India, Dr. N. Annandale, was earlier determined by Brunetti as being identical with his *O. peregrina*, described from the Darjiling District, Eastern Himalayas. If Brunetti's description of the latter is even approximately correct, the two species are amply distinct. In *peregrina*, the basal section of R_{4+5} is short, *r-m* and the basal section of R_2 in alignment, and cell M_3 much deeper than its petiole. It should be noted that the types of the present species are the identical specimens taken by Dr. Annandale in Perak.

Helius ferruginosa (Brun.).

Numerous alcoholic specimens, from Kalimpong, Darjiling District, Eastern Himalayas, altitude 600—4,500 feet, April 24—May 10, 1915 (*F. H. Gravely*). These specimens show a considerable range in size, some of them being the largest specimens of *Helius* known to the writer. (*Male.*—Length, 7·5—8 mm.; wing, 7·5—9 mm. *Female.*—Length 9—11 mm.; wing, 8·5—9·5 mm.). They were associated in the vials with *Helius unicolor* (Brun.), *Eriocera aurantia* Brun., *E. flavipes* Brun., *E. gravelyi* Brun., and other species.

Tribe PEDICIINI.

Nipponomyia trispinosa (Alex.).

Otsu, Japan, October 6, 1915 (*N. Annandale*). Small swarms of males dance in the air a foot or two above the ground, among undergrowth, at dusk. Brunetti (*Rec. Ind. Mus.*, XV, p. 328; 1918) failed to recognize the Pediciine nature of these specimens and believed they might represent a new genus of the Hexatomini (Limnophilini). It should be noted that a representative of this peculiar genus, *N. novempunctata* (S.-W.), has been taken in the Khasi Hills, Assam.

Tribe HEXATOMINI.

Pseudolimnophila multipunctata (Brun.).

1912. *Limnophila multipunctata* Brun., *Fauna Brit. India, Dipt. Nemat.*, p. 569.

A badly damaged male, Mangaldai District, N. E., Assam-Bhutan frontier, December 27, 1910 (*S. W. Kemp*). The most conspicuous feature of the fly is the presence of long, silken setae on the legs.

Pseudolimnophila senior-whitei, nom. nov.

1922. *Limnophila multipunctipennis* Senior-White, *Mem. Dept. Agr. India*, VII, No. 9, p. 140, pl. xv, fig. 6 (wing); *nec L.* (*Dicranophragma*) *multipunctipennis* Brun., *Rec. Ind. Mus.*, XV, pp. 329-330, pl. viii, fig. 17 (wing); 1918.

Pseudolimnophila rhanteria, sp. nov.

General coloration dark grey with a bright brown capillary median vitta from the head to the postnotum ; legs yellow, the femoral tips broadly, the tibiae more narrowly, blackened ; wings yellow, heavily spotted and dotted with brown ; *Rs* relatively short, originating just before the middle of the wing-length ; cell *1st* M_2 long and narrow.

Male.—Length, 8 mm. ; wing, 8·2 mm.

Rostrum dark grey, the palpi brownish black. Antennae relatively short, if bent backward scarcely attaining the anterior end of the praescutum ; antennae dark brown, the second scapal segment a trifle brighter colored ; basal segment elongate ; flagellar segments small, short-oval, decreasing in size outwardly, the verticils unilaterally arranged, only a little longer than the segments. Head behind the eyes elongate but not suddenly nor strongly narrowed posteriorly, blue-grey with a narrow bright brown capillary median vitta.

Pronotum large, grey, with a capillary brown line. Mesonotal praescutum grey, the usual median stripe reduced to a capillary bright brown median vitta, the lateral stripes broader, becoming obsolete posteriorly ; scutum and scutellum grey, the centres of the scutal lobes somewhat darker, the median area with the bright brown capillary vitta ; postnotum relatively short, light grey. Pleura grey with a vague narrow darker line on the anepisternum ; dorso-pleural membrane dusky. Halteres yellow. Legs with the coxae brown, sparsely pruinose, the fore coxae paler apically ; trochanters brownish yellow ; femora yellow, the tips conspicuously blackened ; tibiae and basitarsi yellow, the tips more narrowly blackened ; remaining tarsal segments brown ; pubescence of legs of moderate length only, subappressed. Wings light yellow, the base brighter ; a heavy spotted and dotted brown pattern, largest in the stigmal region ; brown dots in all the cells, least abundant in cell *Sc* ; the costal cell has about a dozen such spots beyond *h* ; the spots are larger at arculus, origin of *Rs*, tip of R_2 and at ends of veins Cu_1, *1st A* and *2nd A* ; veins yellow, darker in the infuscated areas ; costal fringe relatively short. Venation : Sc_1 ending opposite the end of *Rs*, Sc_2 at its tip ; *Rs* of moderate length only, arcuated at origin, arising just before midlength of the wing ; R_1 just before the basal section of R_2 strongly arcuated cephalad ; basal section of R_2 very faint to scarcely indicated, lying at midlength of the pale area beyond the stigma, one-half as long as R_{1+2} and about one-fourth as long as R_{2+3} ; veins R_3 and R_4 gently diverging, more strongly so at outer end through the deflection of R_3 toward the wing-apex ; R_{2+3+4} short, about equal to *r-m* ; inner ends of cells R_4, R_5 and *1st* M_2 in straight alignment or nearly so ; cell M_1 present, shorter than its petiole ; cell *1st* M_2 long and narrow, about three times as long as wide, *m-cu* at midlength ; anterior arculus lacking but in one wing of the type appearing weakly preserved.

Abdominal tergites dark brown, the basal segments narrowly brighter brown medially ; transverse impressions conspicuous, black ; basal sternites more reddish brown, the transverse impressions forming almost complete transverse rings ; hypopygium lighter brown.

Hab.—South India.

Holotype, ♂, Kodaikanal, Palni Hills, altitude 6,700—7,000 feet, August 1922 (*S. W Kemp*).

Pseudolimnophila rhanteria is most closely allied to *P. senior-whitei*, nom. nov. (*P. multipunctipennis* S. W., preoccupied), differing in the very different coloration of the antennae and thorax. The venation of the present species is quite distinct in the shorter *Rs* and the long, narrow cell *1st* M_2.

Pseudolimnophila costofimbriata, sp. nov.

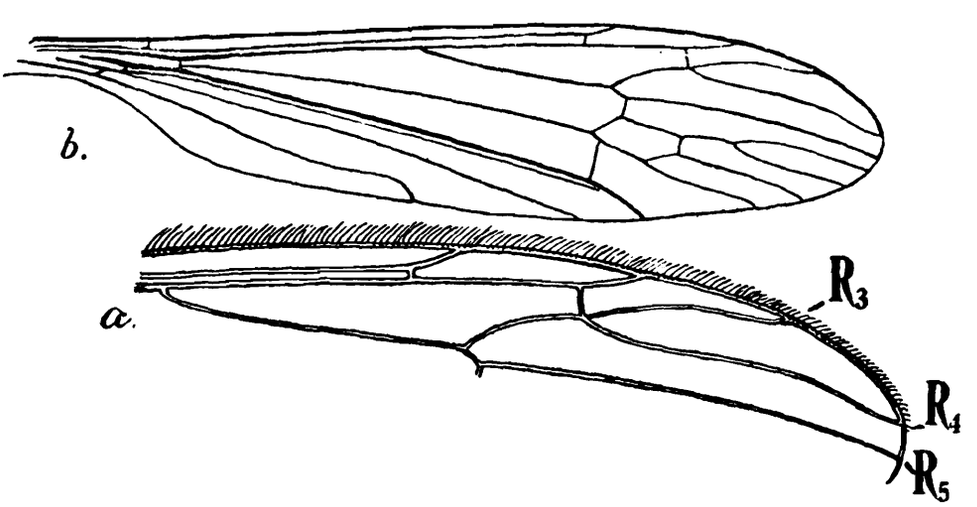
General coloration reddish brown, the praescutum with three darker brown stripes; flagellum with elongate verticils; wings strongly tinged with brown, the stigma darker; costal margin of wings of male with a conspicuous fringe of long setae.

Male.—Length, 6·5—7 mm.; wing, 7—7·5 mm.

Female.—Length, 8·5—9 mm.; wing, 8—8·5 mm.

Male. Rostrum short, pale, the palpi dark. Antennae with the basal segment obscure yellow, the tip darker; remainder of antennae brownish black; flagellar segments elongate with long conspicuous verticils, as in the group, these verticils exceeding the segments in length. Head brown, the front and posterior orbits greyish, the ventral surface of the head more yellowish.

Mesonotal praescutum reddish brown, not shiny, more dusted with grey in front, with three darker brown stripes, the median stripe nearly reaching the suture; pseudosutural foveae large but relatively inconspicuous because of their pale color; tuberculate pits lying far cephalad; scutum brown, each lobe conspicuously variegated with darker brown; scutellum pale reddish testaceous; postnotum brown to dark brown, dusted with grey. Pleura reddish brown, sparsely pruinose. Halteres pale, the knobs infuscated. Legs with the coxae light brown, sparsely pruinose; trochanters obscure yellow; remainder of the legs light



TEXT-FIG. 15.—*Pseudolimnophila costofimbriata*, sp. no
a. Costal fringe of ♂. *b*. Venation.
Symbol: R=Radius.

brown, the terminal tarsal segments a little darker; legs unusually long and slender. Wings with a strong brownish tinge, the costal region a

trifle more yellowish ; stigma distinct, oval, darker brown ; veins and macrotrichiae darker brown. Costal fringe (Fig. 15*a*) very long and conspicuous. Venation (Fig. 15*b*) : *Sc* relatively short, ending opposite or shortly before the fork of *Rs*, Sc_2 not far from its tip ; *Rs* relatively long, nearly straight ; R_{2+3+4} of moderate length, arcuated, the basal section of R_2 close to the fork, in some cases at, in others some distance before, even to a distance equal to its own length, while in other cases it lies beyond this fork, on R_{2+3} ; R_{1+2} at least twice the basal section of R_2 ; veins R_3 and R_4 long, gently divergent ; basal deflection of R_5 shorter than *r-m* ; cell M_1 deep, about twice its petiole or a little less ; *m-cu* not far from the fork of *M* ; anterior arculus evident but only weakly preserved.

Abdominal tergites dark brown, the lateral margins of the segments restrictedly paler ; sternites brown, the segments broadly margined laterally and caudally with yellow ; hypopygium obscure yellow.

Female.—Very similar to the male but with the costal fringe short, but still a little longer than is usual in the genus. Ovipositor with the valves very long and slender.

Hab.—South India.

Holotype, ♂, Kodaikanal, Palni Hills, altitude 6,700—7,000 feet, September 1922 (*S. W Kemp*).

Allotopotype, ♂, August 1922.

Paratopotypes, 8 ♂ ♀.

Pseudolimnophila costofimbriata is readily distinguished from its allies in the Oriental fauna by the long costal fringe of the male. The rather numerous species of this restricted group have *Sc* unusually short, the basal section of R_2 close to the fork of R_{3+4} and with the flagellar verticils of an unusual length. The group may be termed the *inconcussa* group, from one of the earlier described species (*P. inconcussa* Alex., of Japan).

Limnophila (Dicranophragma) reverenda, sp. nov.

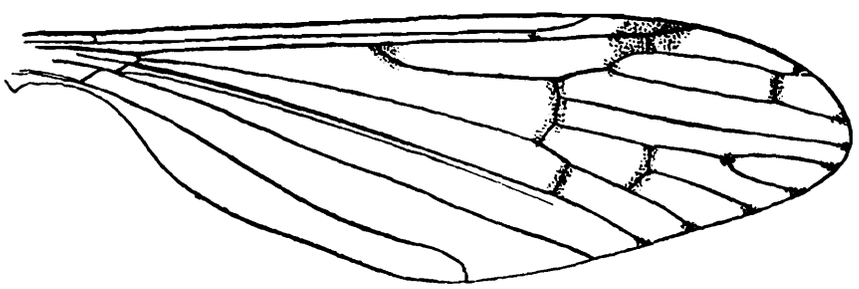
General coloration grey, the praescutum with four dark brown stripes ; pleura largely blackish ; wings greyish yellow, with a very sparse brown pattern, there being no markings basad of the cord except a spot at origin of *Rs*.

Male.—Length about 5·8 mm. ; wing, 6·8 mm.

Rostrum and palpi dark brown. Antennae with the scapal segments dark reddish brown, the flagellar segments darker brown, elongate-oval, with relatively long verticils. Head yellowish grey, brighter in front, darker behind.

Mesonotal praescutum dull grey with four dark brown stripes, the intermediate pair narrower, less distinct in front ; lateral stripes broader but more poorly defined ; pseudosutural foveae shiny brownish black ; scutum dark grey, each lobe variegated with two brown areas ; scutellum broad, brownish grey ; postnotal mediotergite dark blackish grey with a median dark crease (possibly an abnormality of the unique type). Pleura largely blackish, sparsely pruinose. Halteres pale, the knobs weakly darkened. Legs with the coxae weakly infumed, the fore coxae a little darker ; trochanters obscure yellow ; remainder of legs yellow,

the terminal tarsal segments and the incisure between tarsal segments one and two darkened. Wings with a strong greyish yellow suffusion, the centers of most of the cells paler ; a very sparse brown pattern, distributed as follows : At origin of *Rs* ; stigma ; at Sc_2 ; along cord ; outer end of cell *1st* M_2 ; on supernumerary crossvein in cell R_3 ; marginal clouds at ends of veins R_3, R_4, M_1, M_2, M_3, M_4 and Cu_1 ; a series of pale brown clouds on veins M_3 and M_4 and at the fork of M_{1+2} ; no brown marks basad of the cord except the spot at origin of *Rs* ; veins brownish yellow, darker in the infuscated areas. Venation (Fig. 16) : *m-cu* nearly its own length beyond the fork of *M*. One wing of the type is badly deformed in the region of the medial field.



TEXT-FIG. 16.—*Limnophila* (*Dicranophragma*) *reverenda*, sp. nov. ; wing.

Abdomen dark brown, the hypopygium paler ; sternites brownish yellow, margined laterally and less distinctly caudally with blackish, the subterminal segments uniformly blackened. Male hypopygium with the outer dististyle elongate, slender, asymmetrically bifid at apex.

Hab.—North-west India.

Holotype, ♂, in poor condition ; Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, at light (*B. Chopra*).

Phyllolabis confluenta, sp. nov.

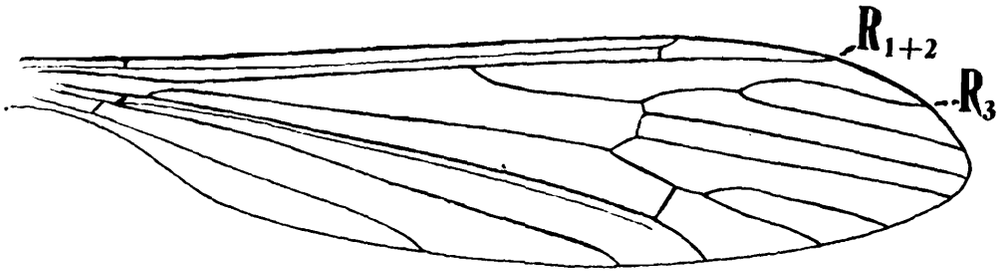
Head grey ; thoracic dorsum brownish black, the pleura obscure yellow ; wings brownish yellow ; cell M_2 confluent by the atrophy of *m*.

Female.—Length, 5·8—6·2 mm. ; wing, 6·7—7·4 mm.

Rostrum light brown, the palpi darker. Antennae with the first scapal segment brownish yellow, the second segment darker, tipped with obscure yellow ; flagellum brown, the flagellar segments gradually decreasing in length and diameter outwardly. Head grey.

Mesonotum shiny brownish black, the lateral margins of the praescutum broadly paler, the median area of the scutellum and the parascutella likewise pale. Pleura pale brownish yellow, a little variegated with vague darker areas. Halteres short, yellow, the knobs brown. Legs with the coxae and trochanters light yellow ; femora brownish yellow, the basal portions clearer ; tibiae brownish yellow, the tips scarcely darker ; basitarsi brownish yellow, the tips and remainder of the tarsi brownish black. Wings with a strong brownish yellow suffusion, the base and costal region somewhat clearer yellow ; stigma lacking ; veins dark brown. Venation (Fig. 17) : *Sc* ending about opposite one-third the length of R_{2+3}, Sc_2 not far from its tip ; R_{2+3+4} only gently arcuated, about one-half *Rs* ; cell M_2 confluent by the atrophy of *m* ;

m—cu about two-thirds its length before the fork of M_{3+4}; Cu_2 ending opposite *m-cu*.



TEXT-FIG. 17.—*Phyllolabis confluenta*, sp. nov.; wing.
Symbol: R = Radius.

Abdominal tergites dark brown, the sternites paler. Genital segment enlarged; valves of ovipositor nearly straight, the tips acute.

Hab.—North-west India.

Holotype, ♀, Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, at light (*B. Chopra*).

Paratopotype, ♀.

Some two years ago Mr. Edwards wrote me that he was describing a new *Phyllolabis* from the Himalayas, but to my knowledge this has not yet appeared in press. It is possible that the above described species will prove to be the same and fall in the synonymy, but it is also very possible that a considerable fauna of the genus will be found in the Himalayan-Tibetan region when further collections are made. In the far western mountains of the United States four distinct species of *Phyllolabis* have been discovered and it is highly probable that still others and possibly several others will be found there. The fact that Mr. Edwards did not mention the open cell M_2 in his species induces me to risk the present description.

Eriocera atrodorsalis, sp. nov.

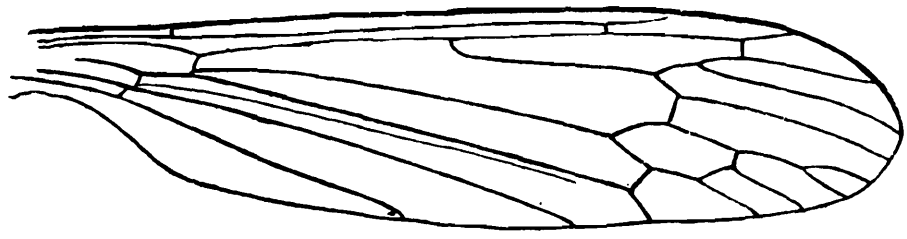
Head and thoracic dorsum dull black; thoracic pleura brownish yellow; legs black, the femoral bases narrowly obscure yellow; wings comparatively narrow, the costal margin and apex blackened; cell M_1 present; abdomen short, dark brown, the basal half of tergite two, the hypopygium, and the basal sternites yellowish.

Male.—Length, 11 mm.; wing, 11·5 mm.; abdomen alone, 7 mm.

Rostrum brown, the palpi black. Antennae black throughout, 7-segmented, the flagellar segments decreasing gradually in length and diameter outwardly. Head dull black, the vertex broad.

Dorsum of thorax dull black, the pleura conspicuously brownish yellow, this including the propleura, dorso-pleural membrane and meso-notal pleurotergite; small black marks on the sternopleurite and meron, adjoining the mid-coxa; a brown area immediately before the haltere. Halteres brownish black, the basal portion of the stem obscure yellow. Legs black, with the coxae and trochanters obscure yellow; the femoral bases rather narrowly obscure yellow. Wings comparatively narrow, the costal margin and apex darkened; membrane pale yellowish, including the wing-base; the darkened area includes cells *C* and *Sc*,

especially outwardly, cells R_1, R_2, R_3 and R_4 being paler brown; all remaining veins narrowly seamed with brown; veins darker brown, those in the yellowish basal area more flavous. Venation (Fig. 18): *Sc* of moderate length only, Sc_1 ending shortly beyond the level of the fork of *Rs*, the exact tip ill-defined, Sc_2 a short distance from the end; *Rs* long, about equal to *R*; R_{2+3+4} a little shorter than R_{2+3}; R_{1+2} about twice the basal section of R_2; *r-m* a little less than its own length beyond the fork of *Rs*; inner end of cell *1st* M_2 strongly arcuated; cell M_1 present, shorter than its petiole; *m-cu* near midlength of the lower face of cell *1st* M_2, longer than the distal section of Cu_1; vein *2nd A* straight.



TEXT-FIG. 18.—*Eriocera atrodorsalis*, sp. nov.; wing.

Abdominal tergite one dark brown; tergite two with the basal half light yellow, the posterior half and tergites three to six dark greyish brown, with the caudal and lateral margins narrowly but conspicuously obscure yellow; tergites seven and eight similar but only the lateral margins pale; impressed areas on the posterior ring of tergite two conspicuous, separated from one another by a distance less than the length of one; on the succeeding tergites these impressed areas become more diffuse, on tergite six dark-colored; lacking on tergites seven and eight; basal sternites yellow; sternites five to seven darker; hypopygium reddish yellow. Abdomen relatively short, the segments much wider than long. Male hypopygium with the outer dististyle a heavily chitinized blackened rod, nearly straight, narrowed gradually outwardly, the tip abruptly narrowed into a slender curved spine.

Hab.—South India.

Holotype, ♂, Marian Shola to Vandaravu, Palni Hills, altitude 7,000—7,400 feet, August 25, 1922 (*S.W Kemp*).

By Edward's key to the Old World species of *Eriocera* (*Ann. Mag. Nat. Hist.*, (9) VIII, pp. 70-78; 1921), the present species runs to couplet 41, disagreeing with both of the included species, *nigripennis* Meij. (Nias, Sumatra) and *semilimpida* Brun. (Assam).

Tribe ERIOPTERINI.

Trentepohlia (Mongoma) choprai, sp. nov.

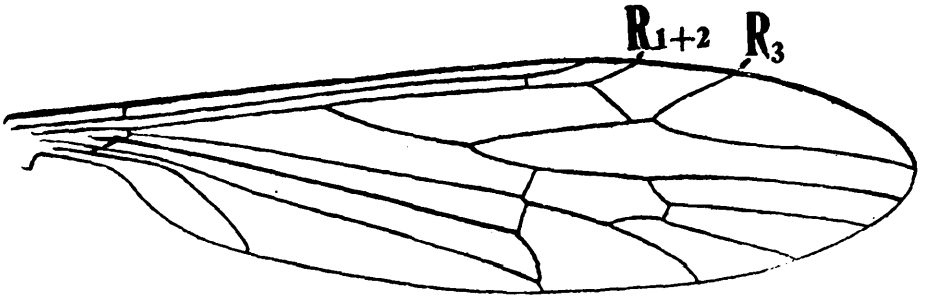
General coloration dark brown; antennae entirely dark; legs dark brown, the tips of all the tibiae and the tarsi dirty white; wings grey, cells *C* and *Sc* a little darker; abdomen dark brown, the sternites a little paler.

Male.—Length about 5·5—6 mm.; wing, 6·2—6·6 mm.

Female.—Length about 6·5—7 mm.; wing, 6·8 mm.

Rostrum obscure yellowish brown, the palpi brownish black. Antennae brownish black throughout; flagellar segments elongate-oval. Head dark; anterior vertex very narrow.

Mesonotum dark brown, the humeral region of the praescutum only vaguely paler; median region of the scutum obscure yellow to yellowish brown. Pleura shiny brown, a trifle paler than the notum. Halteres dark brown. Legs with the coxae and trochanters brown; femora dark brown; tibiae concolorous, the tips broadly whitened, the amount subequal on all the legs and including approximately the distal fifth; tarsi dirty white, the terminal segments a little darker; fore and middle femora with a row of short spines at base; hind tibiae with a long black seta at tip, simulating a spine; basitarsi of middle and hind legs with a basal depression surrounded by long dark-colored setae. Wings strongly tinged with grey; cells *C* and *Sc* darker, the stigmal region very small; veins dark-colored. Venation (Fig. 19): R_{2+3+4} a little longer than *Rs*; basal section of R_2 at or shortly before the fork of R_{3+4}; *m-cu* close to the fork of *M*.



TEXT-FIG. 19.—*Trentepohlia* (*Mongoma*) *choprai*, sp. nov.; wing.
Symbol: R=Radius.

Abdomen dark brown, the centres of the intermediate tergites somewhat paler; sternites paler; hypopygium dark.

Hab.—North-west India.

Holotype, ♂, Simla, Western Himalayas, Station 1, altitude 6,000—7,000 feet, August-September 1925, at light (*B. Chopra*).

Allotopotype, ♀.

Paratopotypes, 5 ♂♂, 2 ♀♀, in jungle.

This interesting crane-fly is named in honor of the collector, Dr. B. N. Chopra. The occurrence of this species together with other crane-flies of undoubted Palaearctic affinities is of unusual interest.

Erioptera (Empeda) monosticta, sp. nov.

General coloration pale yellow; legs with the femora dark, with a narrow pale ring beyond midlength; tibiae snowy-white with about the apical fourth darkened; wings nearly hyaline, veins pale; a single relatively small brown spot near the arculus; *Sc* long, Sc_1 ending shortly before the end of *Rs*, Sc_2 at its tip.

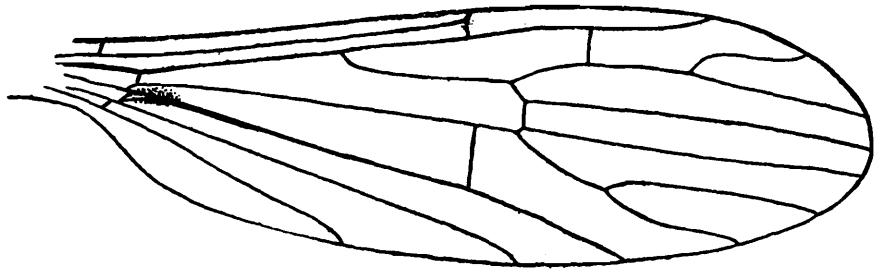
Female.—Length about 3·7 mm.; wing, 3·5 mm.

Described from a specimen preserved in spirit.

General coloration of the entire body pale yellow, the head and pronotum even paler. Antennae with the scapal segments darker than the whitish flagellum. Eyes black.

Legs broken ; a single detached leg in the vial, this pale brown, the base of the femora narrowly paler, with a very narrow pale subterminal ring at near two-thirds the length of the segment ; setae of femora elongate, darkened ; tibiae pure snowy-white, with about the distal fourth darkened, the setae conforming in color with the region whereon located, elongate, especially on the darkened apex ; tarsi pure white, only the terminal segments darkened.

Wings nearly hyaline, the veins very pale ; a single relatively small but conspicuous brown spot at the arculus, at the point of forking of vein *Cu* ; a scarcely evident small cloud at the end of *Sc*. Venation (Fig. 20) : *Sc* elongate, Sc_1 ending only a short distance before the fork of *Rs*, Sc_2 at the extreme tip of Sc_1 ; *Rs* of moderate length ; R_{2+3+4} about two-thirds of R_{3+4} ; R_3 and R_4 generally parallel ; petiole of cell M_3 more than one-half the cell ; *m-cu* nearly transverse, about one-half its length before the fork of *M*.



TEXT-FIG. 20.—*Erioptera* (*Empeda*) *monosticta*, sp. nov. ; wing.

Hab.—Assam.

Holotype, (in alcohol) ♀, Above Tura, Garo Hills, altitude 3,500—3,900 feet, July-August 1917 (*S.W Kemp*).

Erioptera (Erioptera) paivai, sp. nov.

Male.—Length about 2·8 mm. ; wing, 4 mm.

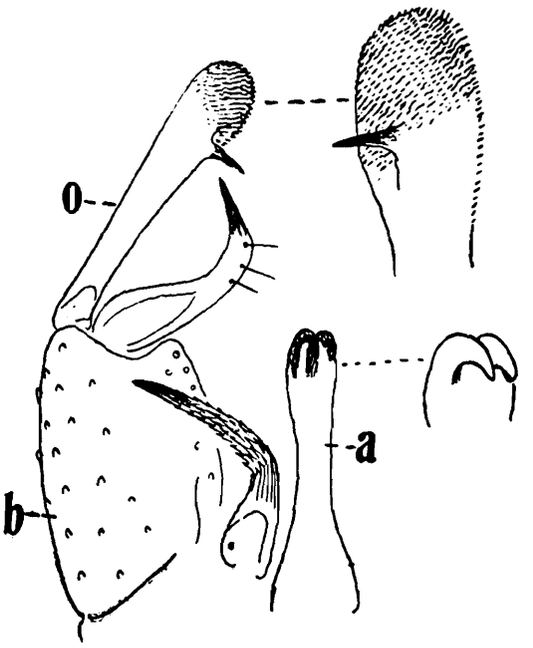
Generally similar to *E.* (*E.*) *alboguttata* Edw. (Formosa), differing especially in the genitalic characters.

Rostrum and palpi dark brown. Antennal flagellum pale. Head pale reddish brown, badly crumpled.

Mesonotum dark greyish brown, the pleura dark brown. Halteres pale, the knobs a little darkened. Legs with the coxae dark ; trochanters pale, the tips darker ; remainder of legs pale yellow, the terminal tarsal segments a little darkened. Wings with a more yellowish ground-color than *alboguttata* but the white spotted pattern quite the same but with the marginal spots somewhat smaller. Wings a little broader with the cells correspondingly widened.

Abdomen dark. Male hypopygium (Fig. 21) with the outer dististyle (o) a somewhat blackened clavate structure, the apex microscopically setulose ; before apex on mesal face with an acute erect spine. Inner dististyle much shorter and more slender, strongly curved, the apex a smooth spine ; at about midlength of the style with three long erect pale setae. Gonapophyses of nearly the same shape as the inner dististyle but the apical point much longer and inconspicuously scabrous except at base and apex. Aedeagus (a) relatively inconspicuous, ter-

minating in two parallel decurved blackened points. In *alboguttata* the outer dististyle has no spine, while the inner dististyle, gonapophyses and aedeagus are all considerably elongated into slender points.



TEXT-FIG. 21.—*Erioptera* (*Erioptera*) *paivai*, sp. nov. ; ♂ hypopygium.
Symbols : a = aedeagus ; b = basistyle ; o = outer dististyle.

Hab.—India.

Holotype, ♂, Darjiling, Eastern Himalayas, altitude 7,000 feet, August 9, 1909 (*C. Paiva*).

This interesting little fly is named in honor of the collector, the late Mr. C. Paiva, who did so much to secure the materials for Brunetti's detailed studies. Although the unique type is in poor condition, there is no question of the validity of the species.

Erioptera (Baeoura) funebris, sp. nov.

General coloration of the body brownish black, the antennae and halteres dark brown ; wings with a strong brown suffusion ; abdomen entirely brownish black.

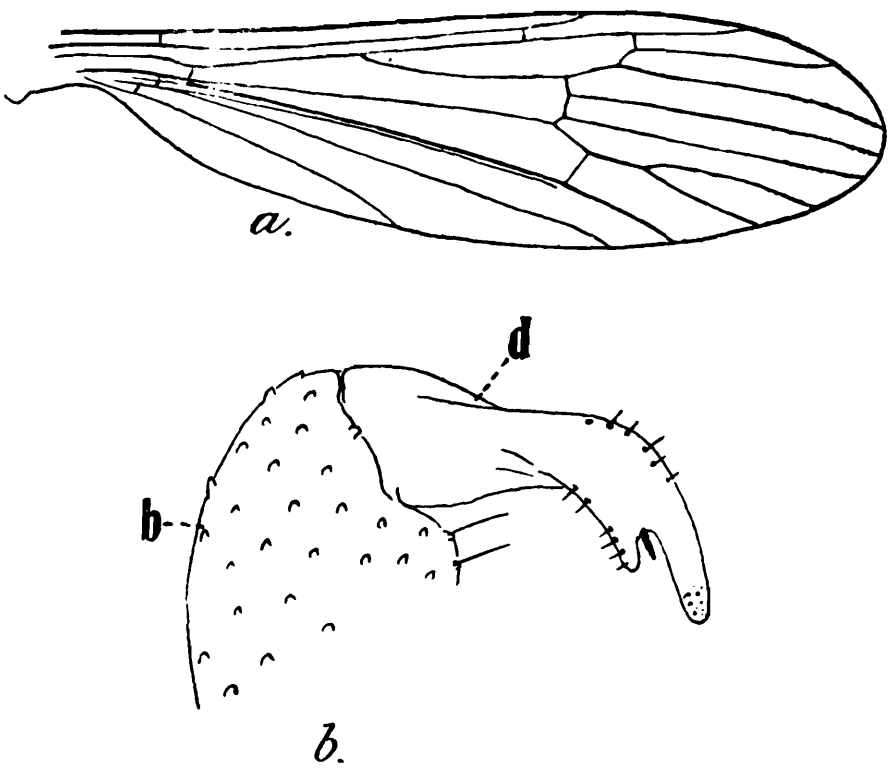
Male.—Length, 3·8—4 mm. ; wing, 5·5 mm.

Female.—Length about 3·5 mm. ; wing, 5·1 mm.

Head, rostrum and palpi black. Antennae with the scape black, the flagellar segments dark brown, oval, in the male with elongat verticils.

Pronotum dark grey. Mesonotum dull black, the scutellum a little pale, the humeral region of the praescutum very restrictedly paler, dirty brown. Pleura black, vaguely pruinose, the dorso-pleural region blackened, a little variegated with obscure yellow before the wing-root. Halteres dark brown. Legs with the coxae and trochanters dark brown ; remainder of legs brownish yellow, with elongate erect setae as in the subgenus. Wings with a strong brown suffusion, with clearer streaks along veins *M*, M_{3+4} and *1st A* ; veins dark brown. Macrotrichiae of veins, and especially the costa, very long and conspicuous. Venation

(Fig. 22*a*) : Sc_1 ending shortly beyond the fork of the long straight *Rs*, Sc_2 not far from its tip ; R_{2+3} and basal section of R_2 subequal ; *m-cu* at midlength of M_{3+4} ; vein *2nd A* elongate, diverging from *1st A*.



TEXT-FIG. 22.—*Erioptera* (*Baeoura*) *funebris*, sp. nov.
a. Wing. *b*. Style.
Symbols : b = basistyle ; d = dististyle.

Abdomen entirely brownish black, including the hypopygium and ovipositor. Male hypopygium with the single dististyle (Fig. 22*b*) as figured. Ovipositor with short fleshy valves as in the subgenus.

Hab.—India.

Holotype, ♂, Sureil, Mangpu, Darjiling District, Eastern Himalayas, altitude 5,000 feet, April-May 1917 (*S. W. Kemp*).

Allotopotype, ♀

Paratopotypes, 2 ♂♂, one pinned with type.

E. (*B.*) *funebris* differs from *E.* (*B*) *distans* Brun. in the larger size and uniformly darker coloration. The male of the latter species has not been described, Brunetti's type being a female and not a male, as stated.

Ormosia takeuchii Alex.

A few specimens were taken at Otsu, near Kyoto, Japan, on October 9-10, 1915, by the late Dr. Annandale. They were associated in collections with certain other Japanese Tipulidae, as *Limonia machidai* (Alex.), *Nipponomyia trispinosa* (Alex.) and *Pseudolimnophila inconcussa* (Alex.).

Molophilus kempi, sp. nov.

Belongs to the *gracilis* group ; allied to *M. assamensis* Brun. ; general coloration of body, antennae, halteres and legs blackish ; wings tinged

with brown ; vein *2nd A* relatively short, ending before the level of *m-cu* ; male hypopygium with the two dististyles both simple, both blackened and acute at tips.

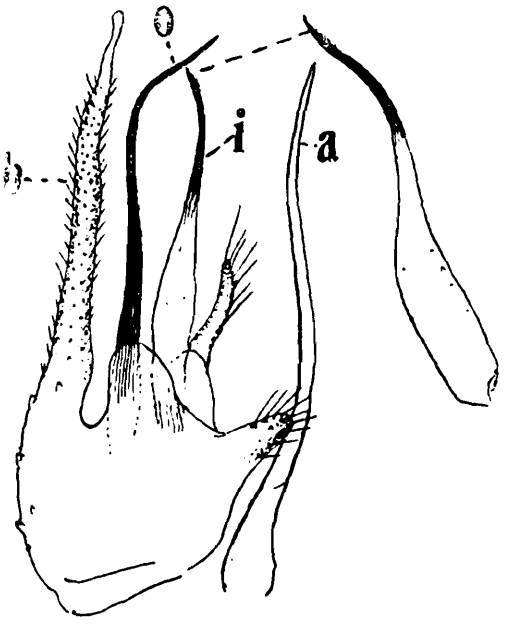
Male.—Length about 3·8 mm. ; wing, 4·6 mm. ; antenna about 3·3 mm.

Female.—Length about 5 mm. ; wing, 5·6 mm.

Rostrum and palpi black, the latter relatively elongate. Antennae (♂) elongate, if bent backward extending about to midlength of the abdomen, black throughout ; flagellar segments elongate-fusiform, with abundant long erect setae. Head dark grey.

Pronotum dark medially ; anterior lateral pretergites obscure orange. Mesonotum dark blackish grey, the praescutum with a very small obscure orange spot on the humeral margin, confluent with the anterior lateral pretergites ; pseudosutural foveae conspicuous, blackened. Pleura blackish. Halteres relatively short, brownish black. Legs with the coxae and trochanters black ; remainder of legs brownish black, the femoral bases only narrowly more yellowish, the middle femora uniformly darkened. Wings with a strong brown suffusion, the veins and macrotrichiae darker brown. Venation : R_{4+5} about one-third longer than *m-cu* ; basal section of R_5 short but distinct ; basal section of M_{1+2} long, in alignment with M ; cell M_3 more than twice its petiole ; vein *2nd A* relatively short, ending shortly before the level of *m-cu*, the distal fourth a little sinuous and deflected slightly toward *1st A*.

Abdomen brownish black, including the hypopygium. Male hypopygium (Fig. 23) with the basistyle (b) relatively large, the ventral face produced into a blunt fleshy lobe ; caudal lateral angle produced caudad into a very long and slender setiferous rod, the extreme tip glabrous, gently sinuous, obtuse ; the setae are erect, covering the surface of the rod almost to the level of the tips of the dististyles ; caudo-mesal region



TEXT-FIG. 23.—*Molophilus kempi*, sp. nov. ; ♂ hypopygium.
Symbols : a = aedeagus ; b = basistyle ; i = inner dististyle ; o = outer dististyle.

of basistyle produced caudad into a small, finger-like, fleshy lobe that is provided with long. unilaterally arranged setae. Outer dististyle

(o) a long slender balckened hook, gradually narrowed to the long curved blackened apex. Inner dististyle (i) a little shorter, the base flattened and here with very sparse setae, the distal third narrowed into a gently curved black spine, the outer margin just before the tip with microscopic setulae. Aedeagus (a) elongate, yellow, the tip acute.

Hab.—India.

Holotype, ♂, Sureil, Mangpu, Darjiling District, Eastern Himalayas, altitude 5,000 feet, April-May 1917 (*S. W. Kemp*).

Allotopotype, ♀.

This interesting *Molophilus* is named in honor of the collector, Dr. S. W. Kemp, who, together with Mrs. Kemp, has added very materially to our knowledge of the Tipulidae of India.

EXPLANATION OF PLATE XIII.

FIG. 1.—*Pselliophora laeta* (Fabr.). Tipulinae—Tipulini.

FIG. 2.—*Stibadocera bullans* End. Cylindrotominae.

FIG. 3.—*Lechria lucida* de Meij. Limoniinae—Lechriini.

FIG. 4.—*Antocha indica* Brun. Limoniinae—Limoniini.

FIG. 5.—*Orimarga horai*, sp. nov. Limoniinae—Limoniini.

FIG. 6.—*Dicranomyia apicalis* (Wied.). Limoniinae—Limoniini.

FIG. 7.—*Tricyphona protea* Alex. Limoniinae—Pediciini.

FIG. 8.—*Nipponomyia kuwanai* (Alex.). Limoniinae—Pediciini.

FIG. 9.—*Adelphomyia flavescens* (Brun.). Limoniinae—Hexatomini.

FIG. 10.—*Erioptera* (*Empeda*) *gracilis* (Meij.). Limoniinae—Eriopterini.

SYMBOLS: A=Anal veins; C=Costa; Cu=Cubitus; *h*=humeral crossvein; M=Media; m-cu=medial-cubital crossvein; *R*=Radius; r=radial crossvein; Rs=Radial sector; Sc=Subcosta.

Labelled according to the Comstock-Needham System, the Cubital field as interpreted by Tillyard, the Radial field as interpreted by Alexander.

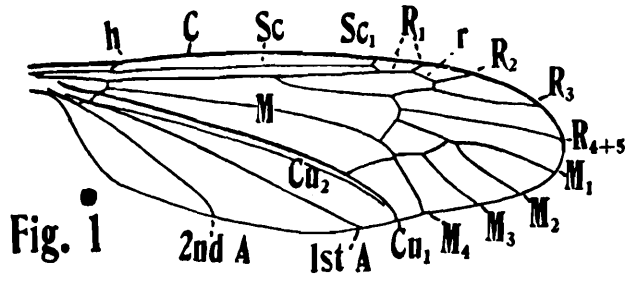


Fig. 1

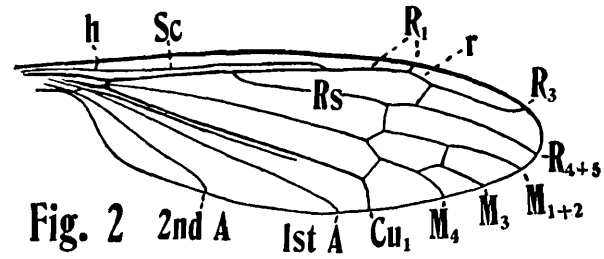


Fig. 2

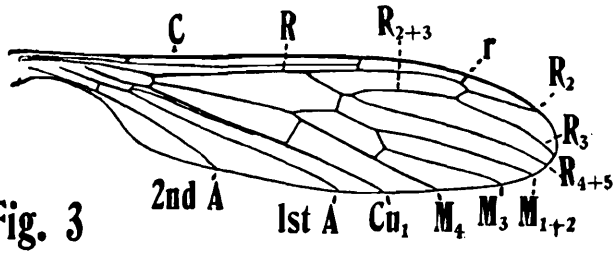


Fig. 3

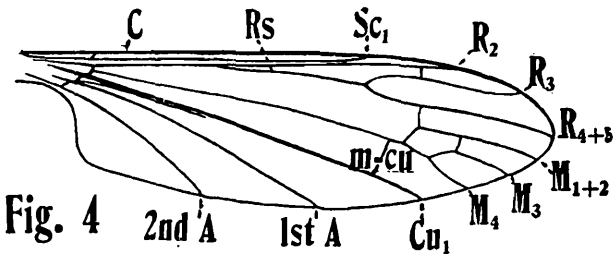


Fig. 4

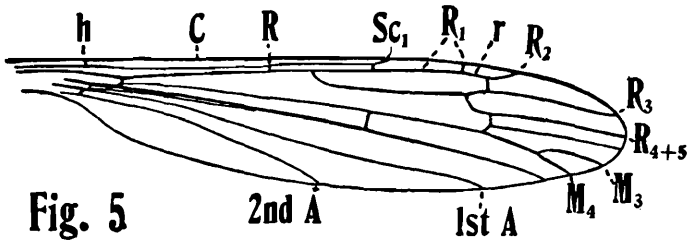


Fig. 5

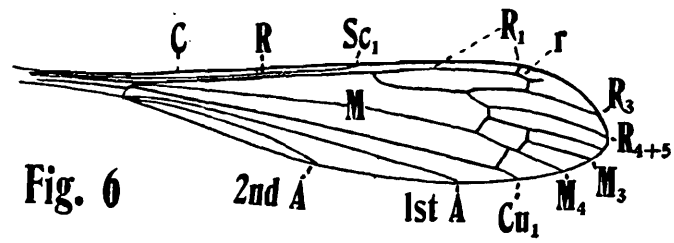


Fig. 6

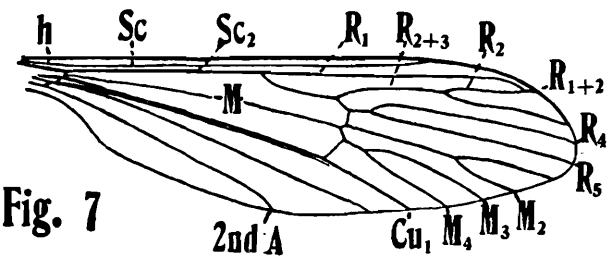


Fig. 7

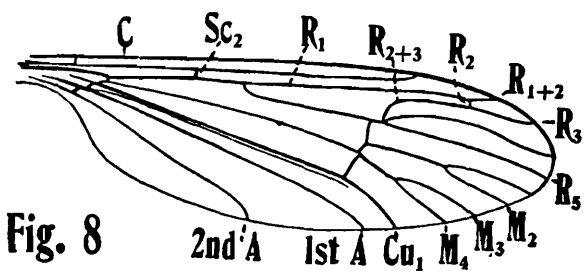


Fig. 8

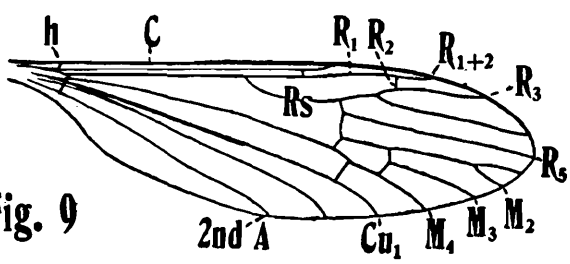


Fig. 9

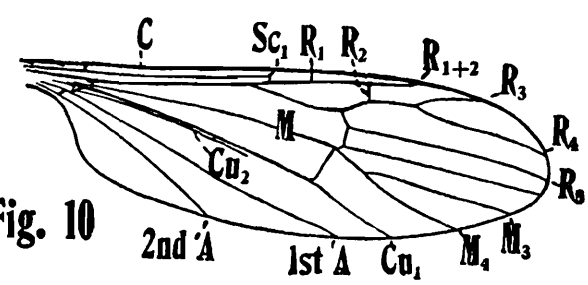


Fig. 10

STUDIES ON ASIATIC HOLOSTOMES (CLASS TREMATODA).

By ERNEST CARROLL FAUST, *M.A., Ph.D.*

(Plates XIV—XXI.)

I. AN UNUSUAL HOLOSTOME, *CLEISTOGAMIA HOLOTHURIANA* FAUST, 1924, FROM THE ANDAMAN SEA.*

This unique holostome was collected by Dr. Stanley W Kemp, late Superintendent, Zoological Survey of India, at Andaman Collecting Station No. 26, in the Andaman Sea. About fifty specimens of this fluke were obtained from the intestinal tract of a holothurian, *Actinopyga mauritiana*, and were lent to me for study and identification. A preliminary report of my findings was presented before the Helminthological Society of Washington (*Journ. Parasitol.*, XI, p. 121 ; 1924), at which time the form was designated as *Cleistogamia holothuriana* gen. et sp. nov.

C. holothuriana is a pyriform organism, measuring from 1·7 to 2·5 mm. in length by 1·2 to 1·6 mm. in breadth with an average measurement of 2·1 by 1·4 mm. The body is concave on the ventral aspect and convex on the dorsum. The posterior end is gracefully rounded while the anterior end projects forward from the body proper as a semi-conical protrusion. The entire body is aspinose and the integument is very thick.

The oral sucker (*os*) is a small muscular organ measuring from 0·083 to 0·1 mm. in length by 0·11 to 0·14 mm. in breadth. The acetabulum or holdfast organ is an unusually large suctorial cup. It consists of an outer muscular suctorial hood (*ohf*) and an inner semi-glandular region (*ihf*) whose function is probably that of the secretion of a viscous substance to assist in attaching the fluke to the intestinal wall of the host. Neither in the mature worm nor in the slightly immature specimens in the collection are there lateral suctorial cups or pockets such as one finds in typical tetracotyliform larvae. Suctorial appendages, which might have been present in the vicinity of the functional ventral sucker during the larval stage, are also entirely wanting in the mature worm. Likewise, the true ventral sucker appears to have entirely disappeared.

The pharynx (*ph*), which lies just inside the oral cavity, is slightly larger than the oral sucker and has the appearance of an inverted truncated cone. Posterior to it there is a very short oesophagus, which forks almost immediately behind the pharynx to form the two digestive caeca. The caeca (*c*) describe a figure like a pair of ice-tongs as they extend posteriad to the subdistal region of the body.

No details of the excretory system have been observed either in *toto* mounts or in sections.

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* Contribution No. 84 from the Parasitology Laboratory, Department of Pathology, Peking Union Medical College.

The genital organs are of unusual significance. The paired testes (t_1, t_2) are oval bodies situated side by side in the anterior plane of the ventral sucker. The ovary (*ov*) is a long sausage-shaped body lying in a nearly vertical plane slightly to the right of the mid-region of the worm and just anterior to the testes. It opens at its posterior extremity through a very short oviduct which proceeds to the ootype (*oo*). The vitellaria (*vit*) consist of large discrete masses of yolk-cells distributed in a fan-shaped pattern in the region dorsal to the holdfast organ. Their ducts gradually coalesce from behind forward, uniting into a common vitelline duct which enters the ootype from the posterior aspect. The seminal vesicle (*sv*) is an elongate oval organ lying for the most part in a vertical plane behind the ventral sucker. The uterus (*ut*) consists of a large thin-walled pouch, the inner opening of which is at the ootype and the confines of which are limited to the median plane between the pharynx and the anterior margin of the holdfast organ, with an out-pocketing extending at times as far posteriad as the middle of the latter organ.

In the respects thus far considered *Cleistogamia holothuriana* differs very little from the genus *Cyathocotyle* (Odhner 1913, Faust 1922). There is, however, this extremely significant difference : neither seminal vesicle nor uterus opens to the outside of the body. Instead, at the posterior end of the seminal vesicle, where a genital pore or a cirrus-sac might be expected, the organ bends abruptly forward and after passing through an annular reinforcement (pl. XV, fig. 2, *a*) becomes constricted into a hollow " chitinous " capillary filament (*cf*), which is here designated as a *cirrus-* or *ejaculatory-filament.* This filament continues its forward course, passing over the holdfast organ, and near the anterior border of this organ is found to be fused with a long sacculate organ, the vagina (*vg*), where, again, an annular reinforcement (pl. XV, fig. 2, *j*) is seen at the junction. The vagina, in turn, opens into the left side of the uterus (*ut*). Spermatozoa have been found at both the proximal and distal ends of this filament although they have not been seen inside the capillary tubule itself. However, the filament has an internal diameter throughout its entire length sufficient to allow several spermatozoa to pass through at one time, so that it is a practical certainty that this organ functions in transferring sperm from the seminal vesicle directly into the vaginal sac, thus obviating the hazard of miscarriage through a genital atrium with an external opening. The process here involved is not merely self-fertilization ; it is obligatory self-fertilization or *cleistogamy*, a process known in the plant kingdom (as for example in certain Violaceae), but apparently unrecorded in the animal kingdom as the sole means of fertilization. The monogenetic trematode, *Polystoma integerrimum*, has, to be sure, as a part of its dimorphic life-cycle (Zeller 1876, pp. 261-268), a period of development attached to the gills of the tadpole, where the customary sexual apparatus, utilized in the more usual cross-fertilization process, has become non-functional and where Zeller (*l. c.* taf. xviii, fig. 18, g) claimed to have found an " inner sperm duct " leading directly from the testis to the oviduct, an observation disputed by Ijima (1884). Even if such a condition obtains in

developed, and then for only one phase of the life-cycle, alternating with the condition commonly found in the trematodes. But in *Cleistogamia holothuriana* the transformation is complete, since there are no vestiges of the usual cirrus organ, genital atrium, or uterine pore.

The egg of *Cleistogamia holothuriana* is also unique for holostomes (pl. XIV, fig. 1*a*). It is ovoid in outline, measuring 92μ in breadth by 77μ in length, while at one end there is a polar filament from ten to twelve times as long as the body length. The filament is frequently coiled on itself like a watch spring. It seems likely that it may serve in rupturing the blind uterine sac and thus allow the dispersal of the enclosed eggs, or it may possibly serve as a means of entanglement and lodgement for the egg in its marine environment, where the chances of continued existence are extremely precarious for so small an organism. In the possession of a polar filament the egg resembles those of certain Monogenea, as well as those of *Halipegus* and certain species of *Allocreadium.*

Discussion.

The intermediate host of this species is not known but it is believed to be a marine mollusc into which the miracidium penetrates, and from which, after the usual processes of parthenogenetic development have taken place, the pharyngeal furcocercous cercaria is derived. The cercaria then infects the holothurian host, becomes metamorphosed into the tetracotyliform larva and eventually into the mature holostome.

The features which distinguish this holostome from all others of the group are undoubtedly adaptations to a marine existence. It seems probable, however, that they represent a side-line of development rather than a main tendency. This genus and species, therefore, is not to be regarded as possessing structures that have been lost but rather more recent modifications that have come about because of the difficulties encountered in propagating its kind in a marine habitat. While it is not unusual to find trematode larvae of the cercarial generation maturing precociously in invertebrates, such hosts are almost without exception regarded as larval or intermediate hosts. The writer has been unable to find any instance, except that of *Aspidogaster*, in which the fluke develops normally to adulthood in an invertebrate. Such seems to be the case in *Cleistogamia.* Furthermore, there appears to be no trematode, either larva or adult, which has been recorded from a holothurian. The host for this mature holostome is, therefore, as unique as the modified structures which distinguish the parasite.

DESIGNATION OF *Cleistogamia holothuriana,* FAUST 1924.

Genus, *Cleistogamia.* Mature holostome, oval to pyriform in shape, 2·1 by 1·4 mm., concavo-convex, with large functional ventral sucker; testes, 2, symmetrically placed in the anterior plane of ventral sucker; ovary, an elongate sac to the right and in front of the testes; seminal vesicle, elongate oval, with no external opening but with a long capillary cirrus filament extending directly to a vaginal sac, which, in turn, runs into the uterine pouch, through which channel spermatozoa appear to be transferred to the uterus; uterus a blind thin-walled sac, lying

between the pharynx and the holdfast organ ; ova, 92 by 77μ, with a long polar filament. Genus, *monotypic*. Only known species,—*C. holothuriana* with characteristics of the genus. Host, a holothurian.

In view of the differences obtaining in the genital organs of *Cleistogamia holothuriana*, which distinguish it from all described holostomes, it is necessary to create for this genus and species a new sub-family, Cleistogamiinae, which is characterized by a cleistogamous type of fertilization, involving a direct connection from the seminal vesicle to the uterus through an ejaculatory filament and vaginal sac. This sub-family is placed close to the sub-family Cyathocotylinae Muehling 1898 (family Strigeidae Railliet 1919). It is monogeneric.

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II. Holostomes from Fishes of Central Asia.*

In the collection of fishes made by the Zoological Survey of India from Kashmir and Seistan there were several species infested with trematode cysts. Through the kind permission of the late Dr. Nelson Annandale the writer has been enabled to examine representative specimens from these collections. Study of the cysts after sectioning and reconstruction of models of the enclosed larvae has revealed the presence of three species of holostome adolescariae new to science. In view of the fact that the fishes involved are commonly caught for food and that the flukes may possibly become parasites of man if the fishes are consumed raw or insufficiently cooked, the findings have an economic and possibly a medical significance.

Diplostomum schizothoracis, sp. nov.

(Plate XVI ; pl. XVII, XIX, figs. 9*a*—*d*.)

These larval flukes were found encysted in and under the skin of *Schizothorax zarudnyi* Nikolsky, collected by Drs. N. Annandale and S. W. Kemp in the pools among the reeds of the Hamun-i-Helmand, near Lab-i-Baring, Seistan, Persia. Annandale and Hora (1920, p. 173) refer to the infestation as follows : " Both large individuals (of *S. zarudnyi*)

* Contribution No. 85 from the Parasitology Laboratory, Department of Pathology, Peking Union Medical College.

from the Hamun and young ones from small pools were infested by an immature trematode, which was encysted in their skin, in the superficial muscles, in the membrane of the fins and on both the outer and inner aspect of the operculum. The cysts were of a blackish colour and resembled those shown in Herzenstein's figure of *S. altior* (*op. cit.* pl. xii, fig. 1)." In a later publication from the same laboratory (Kemp, 1921, pp. 232-233) Annandale figured *toto* mounts of the larva but was unable to decide the taxonomic position of the organism. His statement of the difficulties encountered in sectioning the cysts has been borne out by the writer's attempts to secure satisfactory material for study.

Description of the Parasite.

In preserved specimens of this host the cysts consist of spherical nodules situated in or under the skin and ectodermal membranes and giving rising to rounded elevations. They measure up to 2 mm. in diameter and appear dark brown or black to the naked eye. They are most conspicuous on the head, opercula and fins of the fish, but are also seen without difficulty in the superficial muscles, since the scales of this host are small and relatively transparent (see pl. XVII, fig. 6). On section of the cyst the pigmentation is found to be laid down in the secondary (outer) cyst-wall around the thick elastic hyaline inner or true cyst-capsule. The pigment consists of dark brown granules arranged in an arabesque pattern fitting around the true cyst-wall and interwoven on its outer aspect with the host tissue. It is thus a host production, its deposition being heaviest around the cysts in the superficial tissue where melanophores are most common.

The inner true cyst-wall is a hollow sphere, varying from 0·35 to 0·5 mm. in outer diameter, and having a thickness of 25 to 30μ. The wall substance is non-cellular, consisting of a tough elastic hyaline or semi-opalescent material, which is extremely resistant to the microtome knife, so that in preparing sections of the larval fluke residing within the capsule it has first been necessary to dissect off the wall. This has been successful in only three or four out of hundreds of attempts made by the writer, due to the fact that the larva is much softer than the cyst-wall and almost invariably breaks in attempts to dissect it out of the capsule.

The young encysted fluke is bent upon its ventral side and its anterior end is frequently folded to one side to fit the spherical prison house. Annandale's sketches (Text-fig. 2 A, B, C, in Kemp, 1921) give a fair idea of the external appearance of the partially extended fluke, although he figures the worm up-side-down. In order to get a correct idea of the relationship of the various organs the writer has supplemented his study of transverse sections of the larva with a wax-model reconstruction and on the basis of the two has sketched the ventral and lateral aspects of the extended fluke (pl. XVI, figs. 5, 5*a*). It appears as a broadly oval or slightly pyriform object, 0·65 mm. long by 0·47 mm. wide, and with a maximum thickness of 0·25 mm. from the ventral margin of the outer cup wall to the dorsum. It is broader anteriorly than posteriorly. On ventral view it reminds one of a low thick-walled bowl with incurved

margin notched at one end (the posterior end of the organism). The ventral cavity thus produced constitutes the inclusive suctorial cup of the fluke. The worm is completely aspinose.

The anterior sucker (*os*) is situated just in front of the suctorial cup or just at its anterior margin. It measures about 50μ in greater diameter. A pharynx (*ph*) lies immediately behind the oral sucker; it measures 40 μ in cross section. A very short oesophagus leads into two long caeca which extend into the posterior fifth of the body. Along the mid-line within the concavity of the inclusive suctorial cup, are two acetabula, a small one, measuring 60μ in transverse diameter, at the junction of the anterior and middle thirds of the body, and a much larger one, 150μ in transverse diameter, situated somewhat behind the middle of the body. The anterior one (*vs*) is apparently the ventral sucker, while the posterior one is probably the accessory holdfast organ (*hf*). The genital anlagen (*ga*) are still undifferentiated; they consist of three club-shaped elements, one lying to the right of the holdfast organ, one immediately behind it and the third situated some distance posteriorly and extending dextrad above the right digestive caecum. The former two elements are attached proximally to the inner portion of the holdfast organ (see pl. XVI, figs. 5, 5*a*, also pl. XIX, figs. 9*a*—9*d*).

Although this organism is immature its relationship to the genus *Prohemistomum* Odhner 1913 is fairly certain. If this assumption is correct, the position of the two anterior genital anlagen with respect to the holdfast organ is indicative of the earlier distomate history of this genus, while the posterior element (possibly the anlage of the cirrus pouch) is suggestive of the later holostomate modification.

Strigea annandalei, sp. nov.

(Plate XVIII, fig. 7; pl. XIX, fig. 10*a*—*c*; pl. XX, figs. 12, 13.)

This larval strigeid was obtained from a small loach, *Nemachilus rupiculus* McClelland, obtained by the Kashmir Survey Party of the Zoological Survey of India from Sonamarg Nullah and from the hill streams of Kashmir. The hosts examined by the writer were studded with black nodular elevations (pl. XX, figs. 12, 13), marking the location of the encysted parasites. The latter were imbedded in the subcutaneous and muscular layers, elevating the outermost tissues in the manner described. The true cyst was found to be surrounded by a layer of fibrous connective tissue with extensive melanoid pigmentation. The gross diameter of the cyst, with its outer pigmented wall laid down by the host, was about 0·45 mm., while the diameter of the true cyst capsule was about 0·34 mm. The capsule, which was secreted by the fluke at the time of its encystment, consisted of a thick-walled hollow sphere, about 20 μ in section and having a semi-translucent appearance.

Description of the Parasite.

In order to study the encysted larva it was necessary to section the cysts and make a wax-model reconstruction. Although sectioning was possible without dissecting the organism out of the cyst capsule, considerable difficulty was experienced in interpreting the reconstructed

model, due to the fact that it was tightly twisted and folded upon itself. It was found, however, that the fluke consisted of an anterior hollow suctorial cup and a posterior fleshy portion, the two parts being connected with one another by a pipe-stem middle region. Thus in sections of the worm (pl. XIX, figs. 10*a*—10*c*) cut sagittally through the anterior end, the posterior portion appears in oblique or nearly transverse section. The sketch (pl. XVIII, fig. 7) represents the entire worm as extended after dissection out of the cyst capsule. It resembles a large-bowled, thin-stemmed pipe with an inflated mouth end. The entire organism is delicately spinose.

The extended reconstruction measures one millimeter in length. The cross diameter of the cup is 0·28 mm. and its depth 0·38 mm. The neck is about 0·34 mm. long by 40μ in cross section. The posterior fleshy portion has a length of 0·5 mm. and a transverse diameter of 0·26 mm. The oral sucker (*os*) is very minute (15μ in section) and is situated just within the posterior rim of the cup. The ventral sucker (80μ in greatest diameter) lies well down within the posterior wall of the cup. There is no evidence of any holdfast or accessory suctorial apparatus. Within the oral opening are a short prepharynx, a pharynx (*ph*), 24μ in transverse diameter, and a long oesophagus, the last organ bifurcating just anterior to the plane of the ventral sucker. The caeca extend into the subdistal region of the posterior fleshy portion of the body.

The genital anlagen are well developed. They are all contained within the posterior portion of the body. By comparison of sections (pl. XIX, figs. 10*a*—10*c*) with the reconstructed drawing (pl. XVIII, fig. 7) the following organs can be made out : (1) an ovary (*ov*), lying well forward in the fleshy posterior region, and connected by a coiled duct, the uterus (*ut*), with the posterior genital atrium ; (2) two relatively large testes (t_1, t_2) in tandem arrangement behind the ovary, with efferent ducts joining to form the vas deferens (*vd*), which, in turn, leads into (3) the seminal vesicle (*sv*). This latter organ opens into a canal (the cirrus-sac), which empties along with the uterus into the genital atrium. The latter organ has the usual genital pore (*g.p.*). The various ducts in question are not solid cords of cells but hollow tubules, while the seminal vesicle is also a hollow sac (see pl. XIX, fig. 10*c*), indicating that the genital organs are far along in their development. In sections (pl. XIX, fig. 10*c*) elements of the vitellaria (*vit*) have also been observed, although the full distribution of these bodies has not been worked out. They appear to be confined to the posterior part of the larva.

The general shape of the oragnism together with the early differentiation of the genital organs make it clear that the organism should be placed in the genus *Strigea*.

Neodiplostomum kashmirianum, sp. nov.

(Plate XVIII, fig. 8 ; Pl. XIX, figs. 11*a*—*b* ; Pl. XX, fig. 14.)

Numerous fishes belonging to the species *Schizothorax curvifrons* Heckel, *S. niger* Heckel and *Crossochilus latia* (Ham. Buch.) Day, collected by the Kashmir Survey Party of the Zoological Survey of India, were observed to have splotchy black nodular elevations of the skin, which the writer has found on examination to be holostome cysts, all

of the same species. In the case of the two *Schizothorax* host-species the collections were made from the Jhelum River and from Anchar Lake (Sindh River), Kashmir. In the case of *Crossochilus latia* the specimens were secured from Anchar Lake and Wular Lake, Kashmir. On account of the thicker, tougher skin of the *Schizothorax* specimen infested with this fluke, the elevations at the points of infestation are slight and the pigmented areas more or less confluent one with the other, but in specimens of *Crossochilus* (pl. XX, fig. 14) the pigmented elevations are prominent and discrete. In all of the infested hosts the cysts lie in the subcutaneous or connective tissue layers superficial to the muscles. They are oval-elongated in shape with their long axes parallel to that of the host. The encapsulated cyst measures about 0·55 mm. in lesser diameter and 1·1 mm. in greater diameter. The outer (false) cyst capsule is densely impregnated with melanoid pigment, being drawn out as a whole into more or less pointed ends. It measures 60μ or more in thickness in transverse diameter and up to 230μ from end to end. The true cyst capsule within is thick and tough, frequently resisting all attempts at sectioning. For this reason good sections were obtained only after the larvae had been dissected out of their cysts. The study of this species was made from sections cut from cysts removed from all three species of hosts taken from six different habitats. A wax-model reconstruction was made from sections of the cysts removed from *Crossochilus latia* obtained from the Jhelum River at Srinagar, so that this fish is to be regarded as the type host-species.

Description of the parasite.

The worm within the cyst capsule is bent upon itself, with two main lines of curvature, one just in front of the middle and one just behind the middle of the body. The figure illustrating the reconstructed specimen (pl. XVIII, fig. 8) has been stretched out to represent an excysted living specimen. The worm as a whole has a rounded anterior end, deeply scooped out on the ventral side, and a rounded fleshy posterior end. The integument is aspinose. The dorsal surface-measurement over all is about 1·8 mm., and the ventral 1·1 mm. The hollowed-out anterior portion constitutes about four-fifths of the entire organism. The lateral margins of the anterior two-fifths of the worm fold outward as in adult worms of the genus *Neodiplostomum*. The ventral sucker lies slightly back of the middle of the body. It measures 66μ in diameter. The large muscular holdfast organ, with its deep suctorial pocket, is situated a short distance behind the ventral sucker. It is 140μ long and 160μ deep.

The oral sucker (*os*) is a comparatively minute structure some 20μ in diameter. Immediately behind it lies the pharynx (*ph*), about 35μ in diameter. The oesophagus is very short, branching almost immediately behind the pharynx to form the long slender caeca (*c*) which extend to the subdistal region of the fluke.

The genital anlagen are differentiated in so far as organic masses are concerned, but cellular differentiation has not yet occurred. Thus from their relative positions and sizes (see pl. XVIII, fig. 8 and pl. XIX, fig. 11*b*) the ovary (*ov*), anterior and posterior testes (t_1, t_2), vitellaria

(*vit*), seminal vesicle (*sv*) and cirrus-pouch (*cp*) are distinguishable, although the uterus and the efferent and deferrent sperm ducts are still undifferentiated. The cirrus-pouch is particularly well advanced in its development and possesses muscular elements.

In certain respects this species resembles *Neodiplostomum spathula* (Diesing), but in view of the relatively narrower and longer anterior end, the more distal position of the ventral sucker and holdfast organ and the closer association of these latter organs one with the other, *Neodiplostomum kashmirianum* differs from *N spathula*, and must be regarded as a distinct species.

Discussion.

The three larvae, representing three different subfamilies of the family Strigeidae, which have been described in this paper have the common characteristic of residing in the subcutaneous and superficial muscle-tissues of fresh-water fishes. Except for Herzenstein's figure (1888) showing a cystic infestation of the fins and opercula of a specimen of *Schizothorax altior* from Lob-Nor, collected in 1885, and for Pawlowsky and Anitschkow's description (1923) of *Tetracotyle sogdiana*, obtained from *Schizothorax intermedius* from the Zerabshan River, Samarkand (1908), the holostome parasites from fishes of Central Asia have not been studied. In the case of *T sogdiana*, moreover, the larvae were found encysted in abdominal adhesions and not in the superficial layers of the body.

The recent investigations on the life-history of the Strigeidae by Ruszkowski (1922) and Szidat (1924) indicate that the tetracotyle stage of this fluke is preceded by a cercaria, characterized by the possession of a pharynx and a bifid tail. Cort (1918) and La Rue (1926) have shown by analogies of the excretory system that this group is related to the schistosomes, which also have a fork-tailed cercaria. This cercaria develops in molluscs and upon maturing may either encyst in the same mollusc or may migrate out of this host and invade other molluscs or other host-species, including the lower vertebrates, where it discards its caudal organ and encysts. The species herein described from fishes may be considered as having passed the parthenitic phase of their life-cycle in fresh-water molluscs, after which the mature cercariae had escaped and invaded the superficial tissues of the fish species in question, in which they encysted and were awaiting passive transmission to the next host, probably a mammal or a bird. In view of the relatively advanced condition of the genital anlagen of these encysted flukes considerable development of the larvae must have taken place after encystment. The change in shape from the tetracotyliform larva to the diversified features characteristic of the three respective subfamilies and genera to which the three species belong is also indicative of growth and differentiation. This modification is most striking when the inclusive suctorial cup and the accessory acetabula of the ventral surface are compared with those of the cercariae of this group. While Szidat (*l. c.*) is probably correct in his analogies of these accessory acetabula in the case of his " Cercaria A " and *Tetracotyle typica* Dies., it seems entirely unwise in the light of our present knowledge to jump at the conclusion that this analogy

applies to the entire family Strigeidae. The structural modifications noted by Odhner (1913) in adult forms and by Faust (1919) in the transitional stage, the tetracotyliform larva can not be dismissed as irrelevant to the phylogenetic history of the group. While the cercarial stage and maritae of the Strigeata may be strikingly alike, various modifications and adaptations may have been utilised within the family Strigeidae in the transfer of a preacetabular to a posteriorly disposed genital atrium and pore. If such is the case then the suctorial organs in the mid-ventral line of adult holostomes may not be analogous one to the other. A study of the transitional larval forms of the various subfamilies is most likely to help in elucidating this interesting problem.

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III. Notes on the Life Cycle of *Pharyngostomum cordatum* (Dies).*

Occurrence of the adult worm in China.

During a survey of the termatode parasites of man and domestic animals in the vicinity of Shaohsing, Chekiang Province, China, in March

* Contribution No. 86 from the Parasitology Laboratory, Department of Pathology Peking Union Medical College.

1923, the writer autopsied several cats, one of which contained more than one hundred specimens of a fluke firmly attached to the proximal portion of the ileum. Examination of several *toto* mounts as well as serial sections indicated that the worm was a holostome, belonging to the species *Pharyngostomum cordatum* (Diesing). Some months later the writer received from Dr. Ke-fang Yao three specimens of the same species of worm obtained by him from the intestine of a cat at Changsha, Hunan Province. These two collections of this species are the first known to have been made from Asia, and indicate that the range of this species extends through Asia as well as Europe.

The larval holostome in fishes.

In considering the fluke infections of man and domestic mammals incurred through consumption of raw fish at Shaohsing, two fresh-water fishes, taken from the canals, were found to contain cysts of a holostomate fluke. The species of fish involved were the Chinese bitterling, *Rhodeus sinensis* (Fam. Cyprinidae), and the crab-eating goby, *Eleotris potamophilia* (Fam. Gobiidae). These holostome cysts were easily distinguished from the *Clonorchis*, *Metagonimus* and *Echinochasmus* cysts found in the same fish, since the larvae had neither pigmentation nor oral armature, but were provided with an exceedingly thick hyaline inner cyst capsule and a brownish outer capsule (pl. XXI, figs. 15, 16, 17). the latter being drawn out at opposite poles into finger-like processes. The cyst was readily removed from the outer capsule (*oc*) by slight pressure of the cover glass (pl. XXI, fig. 16). The inner capsule (*ic*), however, was extremely resistent to pressure and attempts to remove it without rupturing the larval holostome residing within were almost always unsuccessful. The cyst with its outer covering measured about 0·38 mm. in length by 0·26 mm. in lesser diameter, while the outside diameter of the spherical inner cyst capsule measured 0·24 mm.

Description of the larva.

On removal of the outer capsule the encysted worm (pl. XXI, fig. 17) was found to be coiled and somewhat twisted upon itself, while the cavity between the larva and the inner wall of the capsule was filled with excretory concretions (*ec*). The integument was spinose. An oral (*os*) and a ventral (*hf*) acetabulum were present, as well as a Y-shaped excretory bladder (*eb*) and cornua. The larva on dissection out of the inner cyst capsule (pl. XXI, figs. 18, 19) measured 0·27 mm. in length by 0·176 mm. in greatest breadth. Its body was found to have a definite division into anterior and posterior portions, the division being more conspicuous from the ventral (pl. XXI, fig. 18) than from the lateral view (pl. XXI, fig. 19). The oral sucker (*os*) measured 40μ in diameter and projected slightly in front of the body. Behind the oral sucker a small pharynx (*ph*), 16μ in diameter, was observed, while a short oesophagus with intestinal caeca diverging posteriorly from it was faintly visible. The posterior portion of the body was approximately hemispherical, measuring 0·176 mm. in diameter and 0·08 mm. in depth, with a cupped-out ventral side having an incurved margin. Protruding

forward out of the anterior face of this concavity was a triangular lappet (*la*), behind which was a mushroom-like acetabulum, the holdfast organ (*hf*), measuring 140μ in width by 70μ in length. On the anterior face this acetabulum was partially fused with the lappet. A ventral sucker, if present, must have lain under the flap, between this structure and the anterior wall of the worm.

The genital anlagen were found to be still immature ; they consisted of one posteriorly disposed muscular organ, probably the cirrus-pouch (*cp*), and three spherical masses of undifferentiated cells (*ga*).

Experimental data.

Portions of the flesh of *Rhodeus sinensis*, heavily infested with these holostome cysts were taken to Peking a few days after their discovery in Shaohsing. The material was fed to a laboratory cat known to be negative for holostomes by repeated faecal examination extending over several months. Two weeks later the cat was autopsied, at which time six hundred and eighty adult specimens of *Pharyngostomum cordatum* were found attached to the wall of the proximal region of the ileum. This experiment, therefore, confirmed the belief which the writer had entertained when he found the adult flukes in cats and the closely related larvae encysted in small fresh-water fishes commonly fed to cats in the vicinity of Shaohsing, namely, that the larvae and adults were one and the same species, and that the cats incurred their holostome infection from consumption of infested fish. Incidentally it is of interest to note that these same species of fish were also a source of infection for *Clonorchis sinensis*, *Metagonimus yokogawai* and *Echinochasmus perfoliatus*, as determined by controlled laboratory experiments in cats and dogs.

A comparison of the larvae (pl. XXI, figs. 18, 19) removed from cysts in the tissues of the infested fish and of the adult worms (pl. XXI, figs. 20, 21) indicates that the two stages of this fluke have many structures in common, although considerable modification has attended the metamorphosis from the larval to the adult form. Examination reveals the fact that the anterior end of the adult comprises a very small and inconspicuous part of the body, being confined to the region in the immediate vicinity of the oral sucker. On the other hand, the ventral sucking cup (*vsc*) of the larva has become even more conspicuous than it was in the larva. The posterior cone of the adult (*pc*) represents new growth to accommodate the genital organs. The holdfast organ (*hf*) has become greatly modified and is completely fused to the lappet (*la*). In the relaxed worm (pl. XXI, fig. 20) this organ lies almost entirely under the lateral foliaceous folds (*f*) which have developed as an enveloping structure within the surface of the inclusive ventral cup ; in the extended worm (pl. XXI, fig. 21) these lateral folds are completely withdrawn against the outer rim of the inclusive ventral sucking cup and the holdfast organ appears as a trilobate structure, with its own suctorial depression. The combined inner and outer suctorial organs thus provide an apparatus for attachment to the intestinal wall of the host so effective that the attached worms appear as cystic excrescences from the host tissue, both in fresh and preserved material. Although the worms can not be removed from their place of attachment without considerable

effort, the function of the sucking apparatus appears to be only for mechanical (*e.g.*, adhesive) purposes, since the mucosa of the ileum within the region of attachment is uneroded. The acetabulum of this species is very small and inconspicuous as La Rue (1926) has shown and can not be seen in surface view. In sections it may be found as a small, almost entirely non-muscular organ on the anterior face of the small pocket formed by the holdfast organ with the anterior end of the worm.

The entire integument of the larva is provided with spines. Such is the case even in immature specimens of the worm removed from the cat. In the adult, however, the integumentary spines are confined to the anterior end and in and around the suctorial apparatus, while the posterior cone is free from spines.

The internal organs of the worm (pl. XXI, fig. 21) correspond to those described by La Rue (*l. c.*) for this species.

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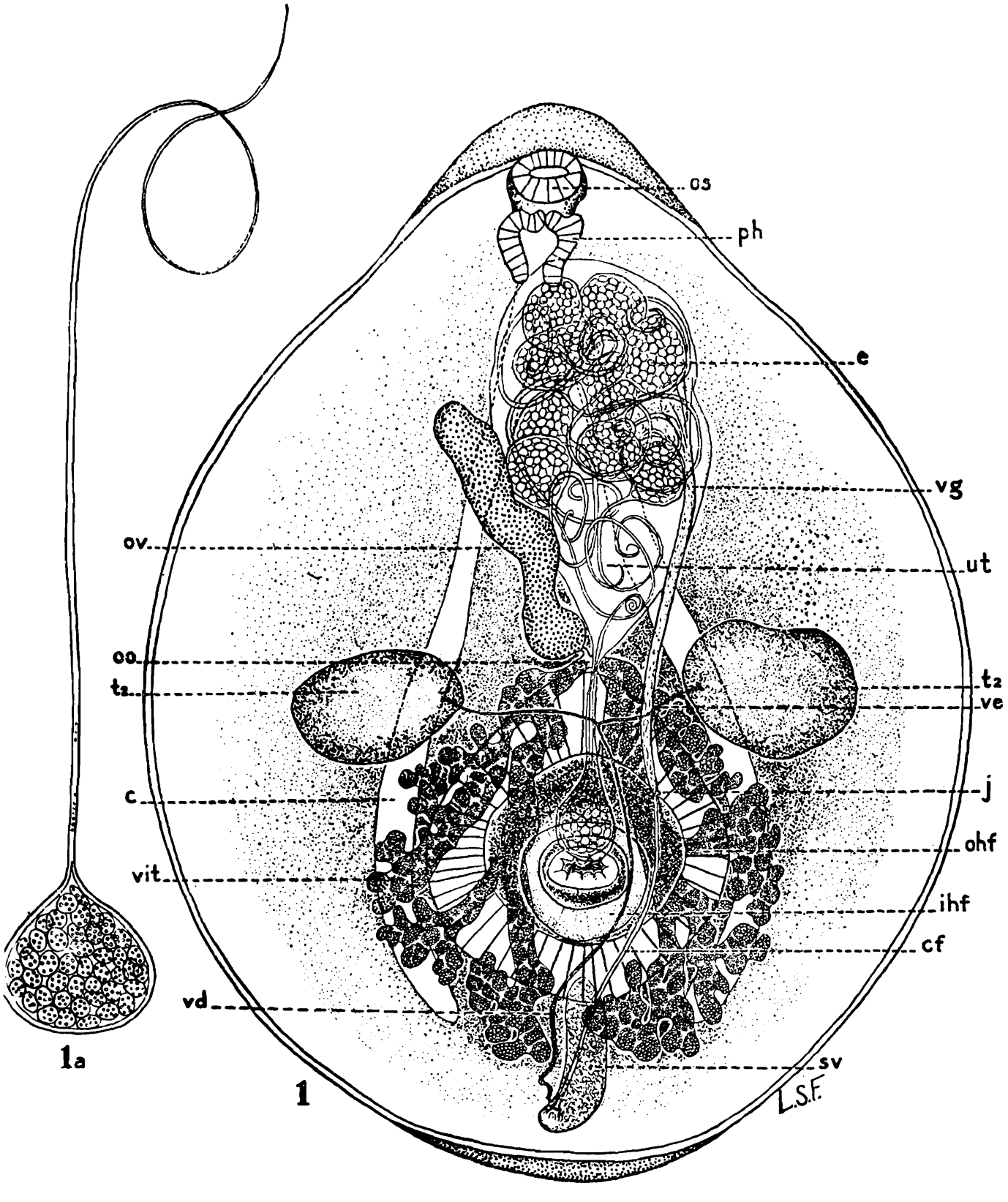
EXPLANATION OF PLATE XIV.

FIG. 1.—Ventral view of mature *Cleistogamia holothuriana*, showing internal anatomy. × 87.

FIG. 1*a*.—Egg of *Cleistogamia holothuriana*. × 260.

EXPLANATION OF FIGURES.

c	caecum.	*ph*	pharynx.
cf	cirrus filament.	*sv*	seminal vesicle.
e	egg in utero.	*t*, t_1, t_2	testis (t_1 anterior, t_2 posterior.)
ihf	inner sucker of holdfast organ.		
j	junction of cirrus filament and vagina.	*ut*	uterus.
		vd	vas deferens.
oo	ootype.	*ve*	vas efferens.
os	oral sucker.	*vg*	vagina.
ov	ovary.	*vit*	vitellaria.
ohf	outer sucker of holdfast organ.		



Asiatic Holostomes.

EXPLANATION OF PLATE XV.

FIG. 2.—Diagrammatic sketch of proximal and distal ends of cirrus filament of *Cleistogamia holothuriana* with adjacent organs, reconstructed from sections. × 400.

FIG. 3.—Transverse section through mid-acetabular region of *C. holothuriana*, showing arrangement of vas deferens (*vd*), junction of cirrus filament with vagina (*j*), vitellaria (*vit*) and caeca (*c*). × 80.

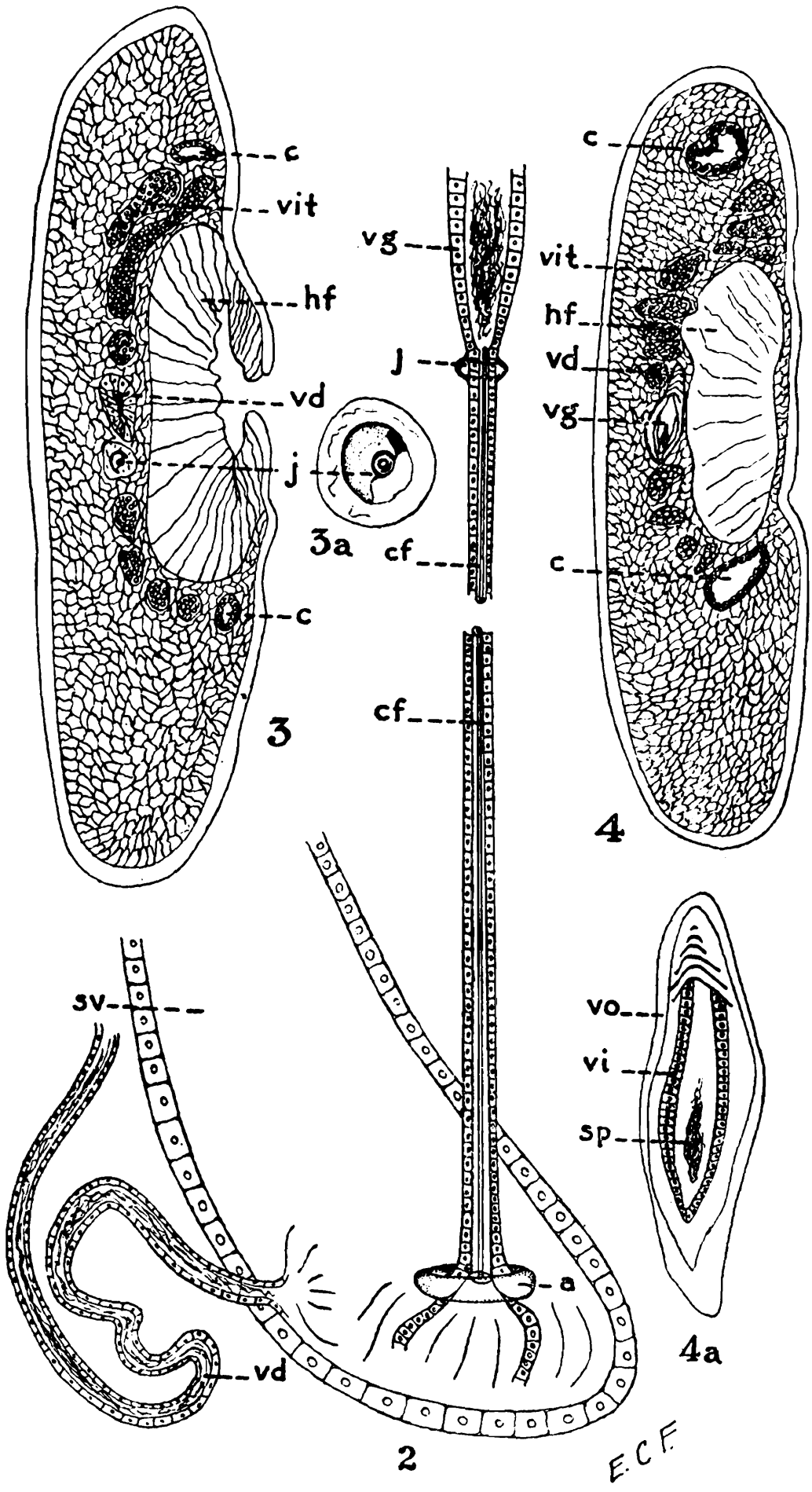
FIG. 3*a*.—Detail from figure 3 of annulus and capillary pore at junction of cirrus filament (*j*) with vagina. × 240.

FIG. 4.—Transverse section through anterior acetabular region of *C. holothuriana*, showing arrangement of vas deferens (*vd*), vagina (*vg*), vitellaria (*vit*), and caeca (*c*). × 80.

FIG. 4*a*.—Detail of vagina (oblique view) from figure 4. × 240.

EXPLANATION OF FIGURES.

a	annulus at junction of seminal vesicle and cirrus filament.	*sp*	spermatozoa.
		sv	seminal vesicle.
		vd	vas deferens.
c	caecum.	*vg*	vagina.
cf	cirrus filament.	*vi*	inner epithelial layer of vaginal wall.
hf	holdfast organ.		
j	junction of cirrus filament and vagina.	*vit*	vitellaria.
		vo	outer layer of vaginal wall.



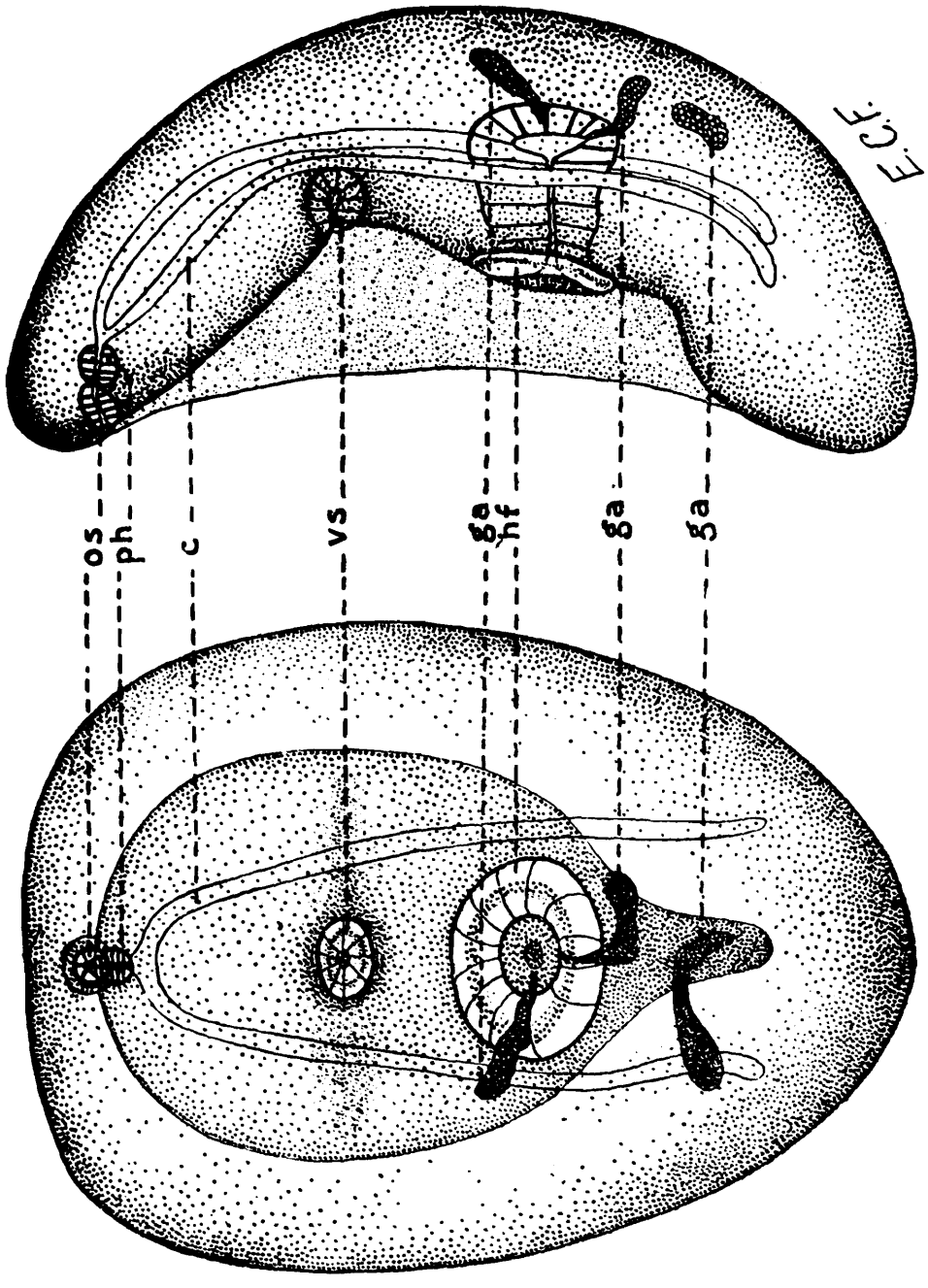
Asiatic Holostomes.

EXPLANATION OF PLATE XVI.

FIG. 5.—Ventral view, and fig. 5*a*, lateral view, of *Diplostomum schizothoracis*, showing body contour, digestive tract, ventral acetabula and developing genital anlagen. × 150.

EXPLANATION OF FIGURES.

c	caecum.	*os*	oral sucker.
ga	genital anlage.	*ph*	pharynx.
hf	holdfast organ.	*vs*	ventral sucker.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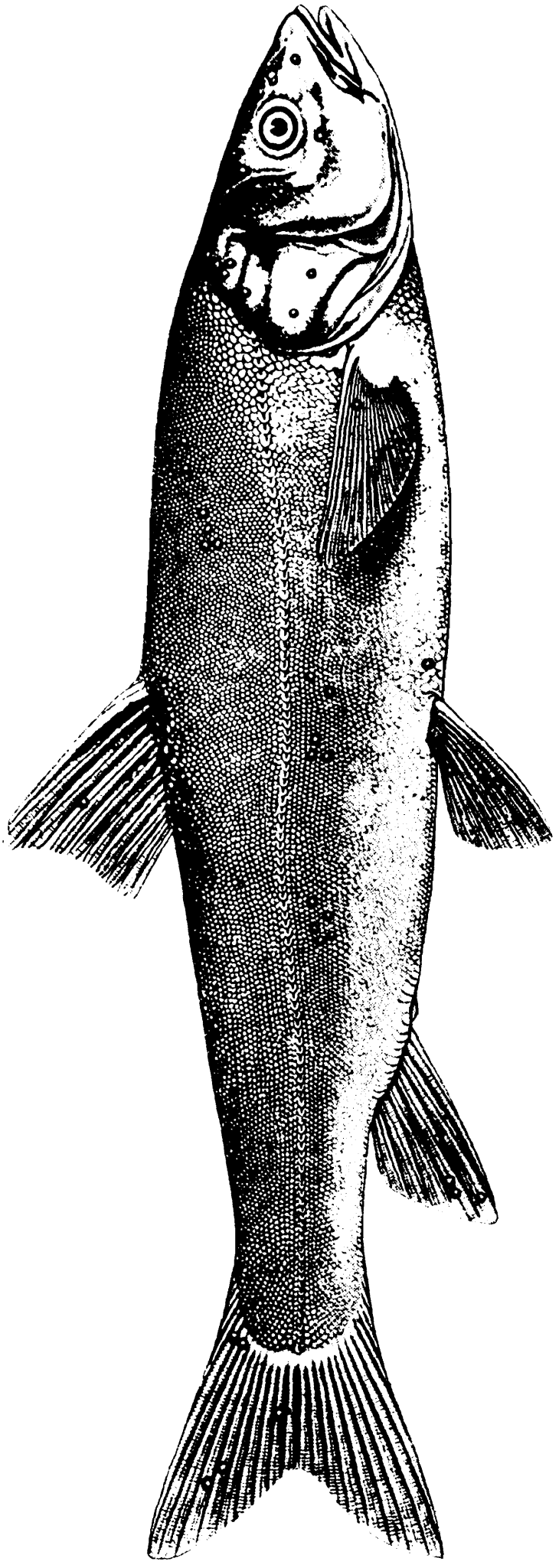
os
ph
c
vs
ga
hf
ga
ga
5

EXPLANATION OF PLATE XVII.

FIG. 6.—Lateral view of *Schizothorax zarudnyi*, showing infestation with cysts of *Diplostomum schizothoracis* in the superficial tissues of the fish. 2/3 natural size.



ASIATIC HOLOSTOMES.

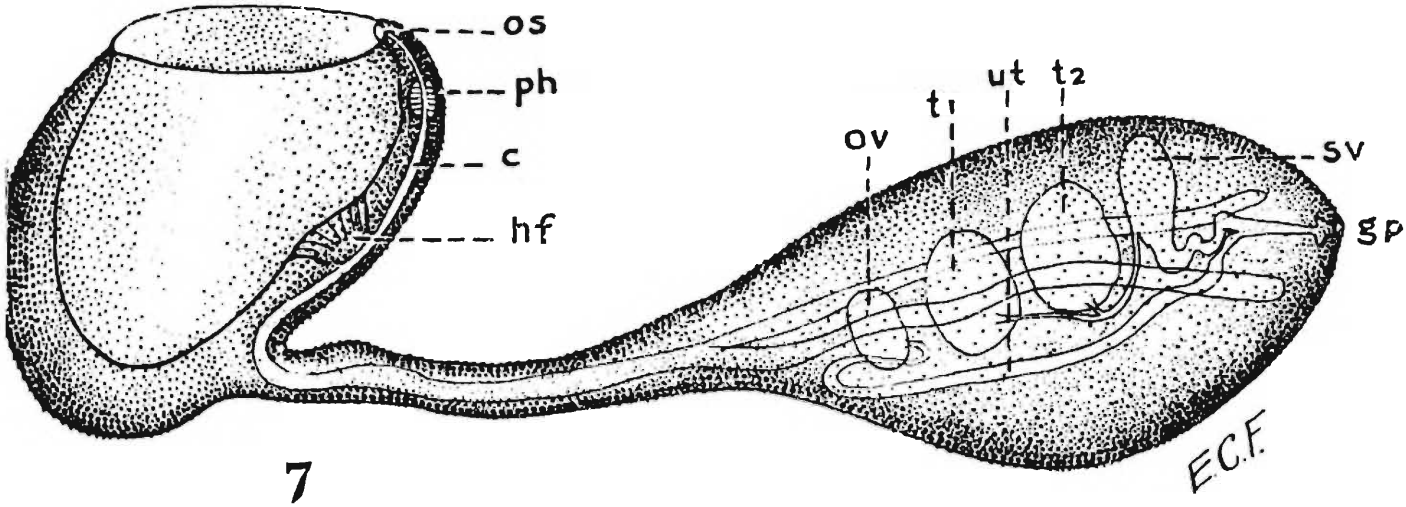
EXPLANATION OF PLATE XVIII.

FIG. 7.—Lateral view of *Strigea annandalei*, showing body contour, digestive tract, acetabulum and developing genital organs. × 150.

FIG. 8.—Lateral view of *Neodiplostomum kashmirianum*, showing organs as in Fig. 7. × 150.

EXPLANATION OF FIGURES.

c	caecum.	*ph*	pharynx.
cp	cirrus pouch.	*sv*	seminal vesicle.
gp	genital pore.	t_1, t_2	testes.
hf	holdfast organ.	*ut*	uterus.
os	oral sucker.	*vit*	vitellaria.
ov	ovary.	*vs*	ventral sucker.



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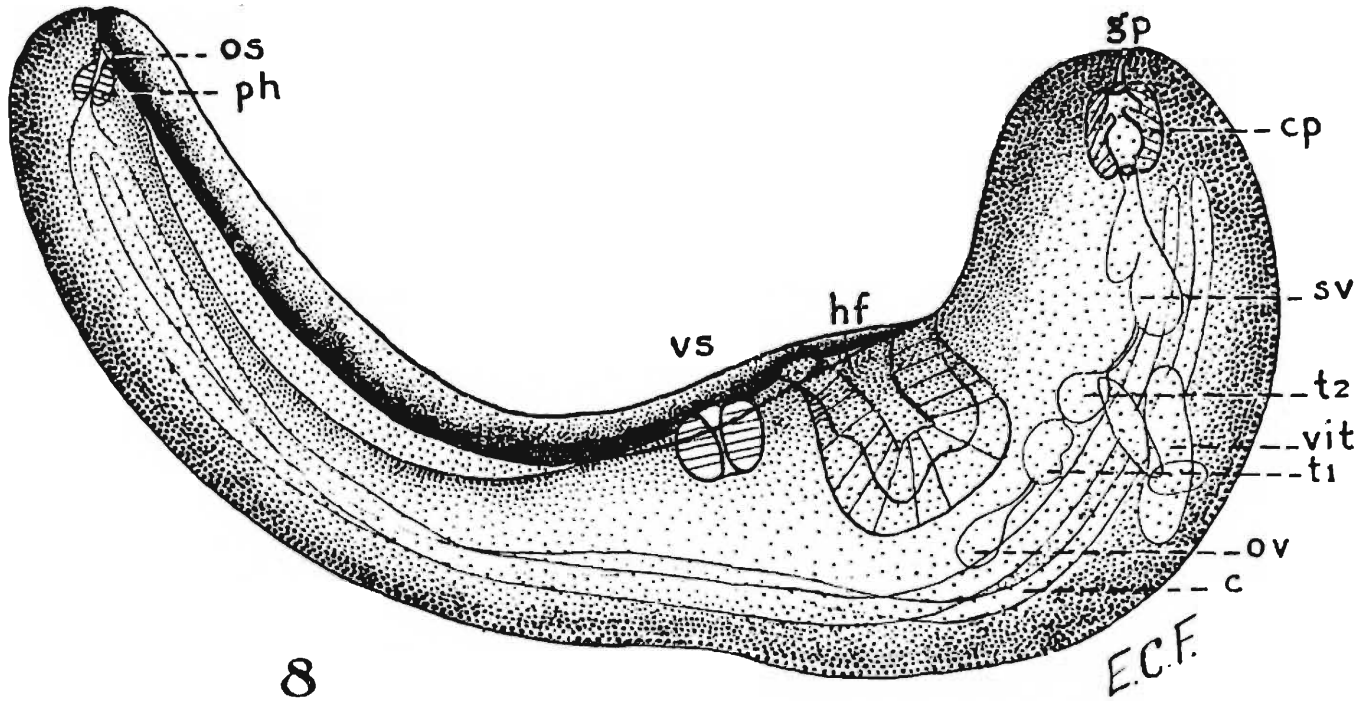

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EXPLANATION OF PLATE XIX.

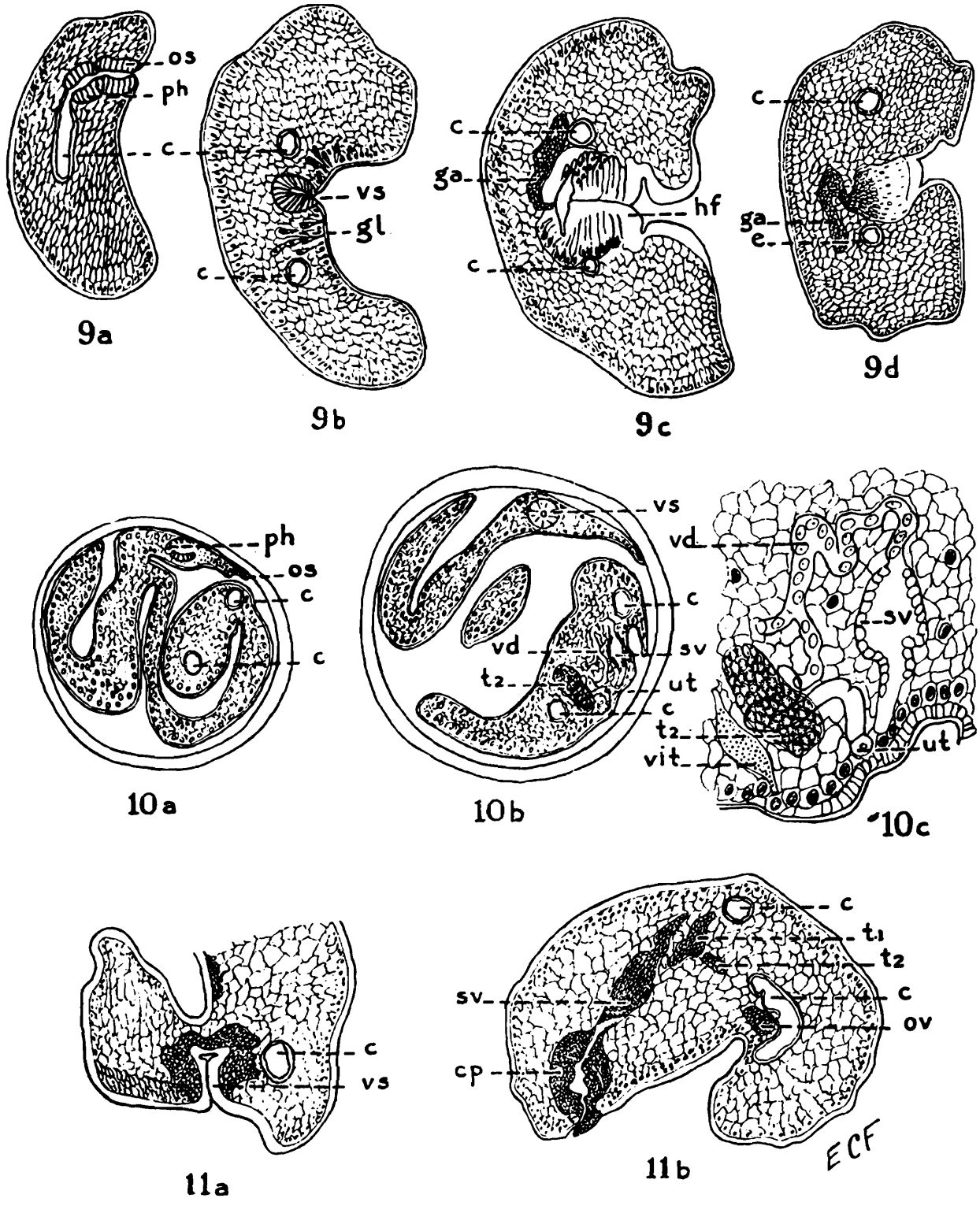
FIGS. 9*a*—9*d*.—Transverse sections through critical regions of *Diplostomum schizothoracis*; 9*a*, anterior end of body; 9*b*, ventral sucker; 9*c*, 9*d*, holdfast organ. × 112.

FIGS. 10*a*—10*c*.—Sections through cyst of *Strigea annandalei*; 10*a*, anterior end in sagittal plane, posterior end in transverse view; 10*b*, ventral sucker in anterior plane, genital anlagen in posterior plane; 10*c*, enlargement of region of genital anlagen shown in fig. 10*b*. 10*a*, 10*b* × 112; 10*c* × 280.

FIGS. 11*a*—11*b*.—Sections through critical regions of cyst of *Neodiplostomum kashmirianum*; 11*a*, section through ventral sucker; 11*b*, section through median plane of genital anlagen. × 112.

EXPLANATION OF FIGURES.

c	caecum.	*ph*	pharynx.
cp	cirrus pouch.	*sv*	seminal vesicle.
ga	genital anlage.	t_1, t_2	testes.
gl	glands.	*ut*	uterus.
hf	holdfast organ.	*vd*	vas deferens.
os	oral sucker.	*vit*	vitellaria.
ov	ovary.	*vs*	ventral sucker.


os
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ov
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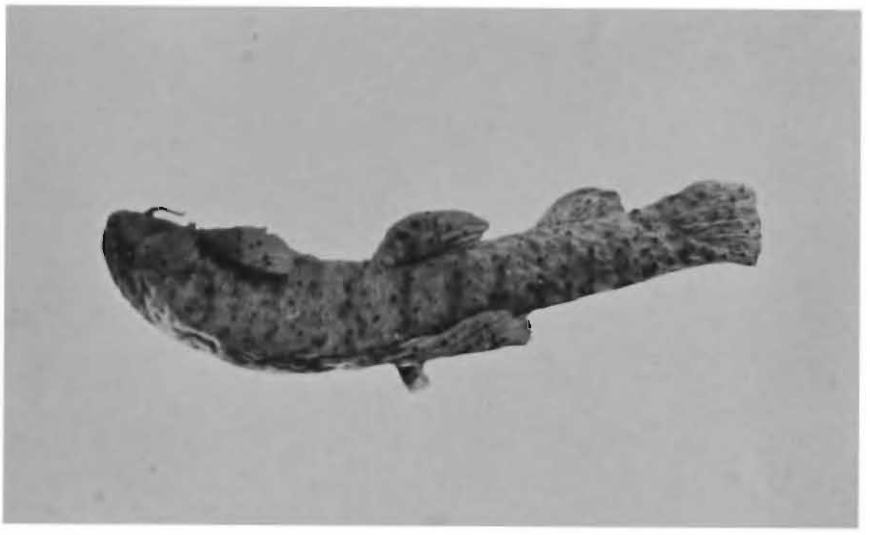
ECF

EXPLANATION OF PLATE XX.

FIGS. 12, 13.—Specimens of *Nemachilus rupiculus* infested with cysts of *Strigea annandalei*. Natural size.

FIG. 14.—Specimen of *Crossochilus latia*, infested with cysts of *Neodiplostomum kashmirianum*. Natural size.



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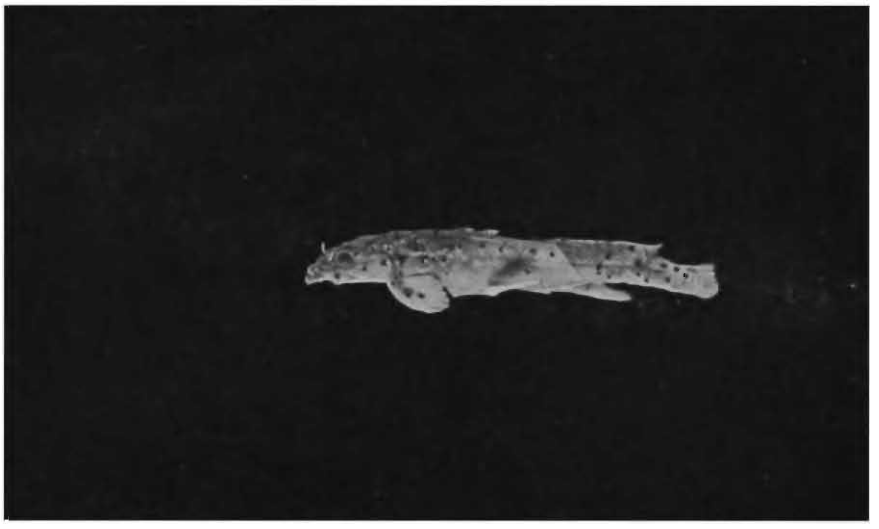

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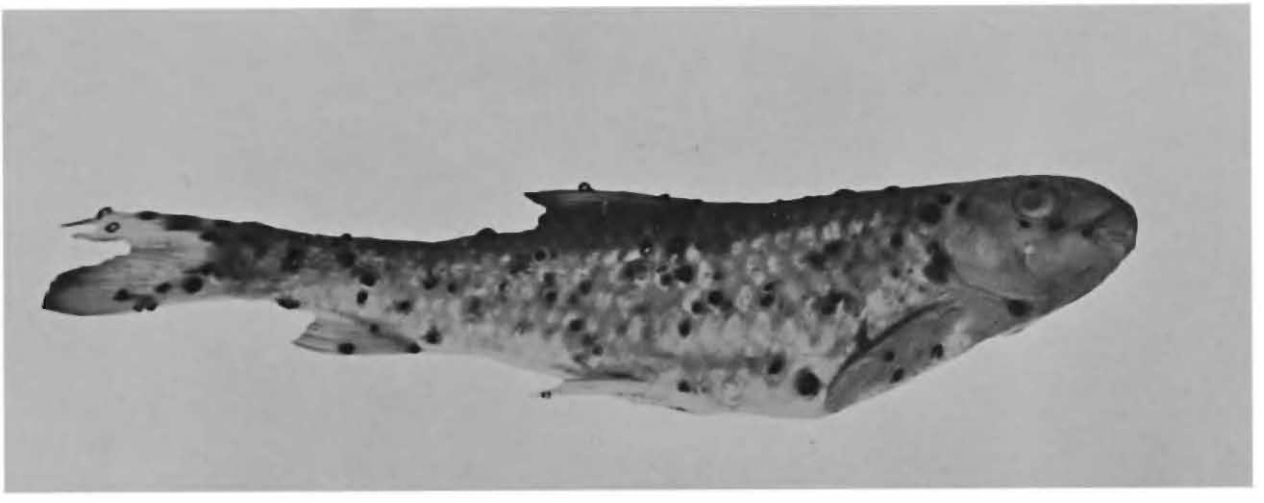

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Asiatic Holostomes

Photo.-engraved & printed at the Offices of the Survey of India, Calcutta, 1927.

EXPLANATION OF PLATE XXI.

FIG. 15.—Cyst of larval *Pharyngostomum cordatum* from flesh of *Rhodeus sinensis*. × 92.

FIG. 16.—Larva of *P. cordatum* within inner capsule pressed out of outer cyst capsule. × 92.

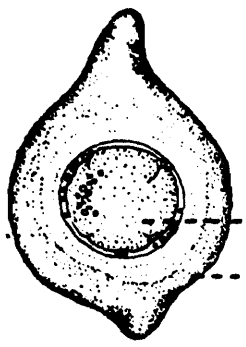
FIG. 17.—Larva of *P. cordatum* within inner capsule, showing important organs. × 230.

FIGS. 18, 19.—Ventral and lateral views of the excysted larva of *P. cordatum*. × 200.

FIGS. 20, 21.—Ventral views of adult *P. cordatum*. Fig. 20, external view of suctorial cup, closed in relaxed specimen; fig. 21, optical view of specimen with suctorial cup open, showing exposed holdfast organ. × 40.

EXPLANATION OF FIGURES.

cp	cirrus pouch.	*os*	oral sucker.
eb	excretory bladder.	*ov*	ovary.
ec	excretory concretions.	*pc*	posterior cone.
f	foliaceous folds.	*ph*	pharynx.
ga	genital anlage.	*sr*	seminal reservoir.
hf	holdfast organ.	*sv*	seminal vesicle.
ic	inner cyst capsule.	t_1, t_2	testes.
l	larva.	*vd*	vas deferens.
la	lappet.	*vsc*	ventral suctorial cup.
oc	outer cyst capsule.		



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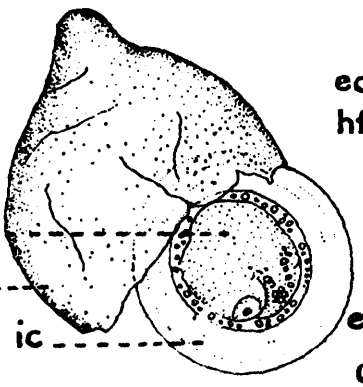

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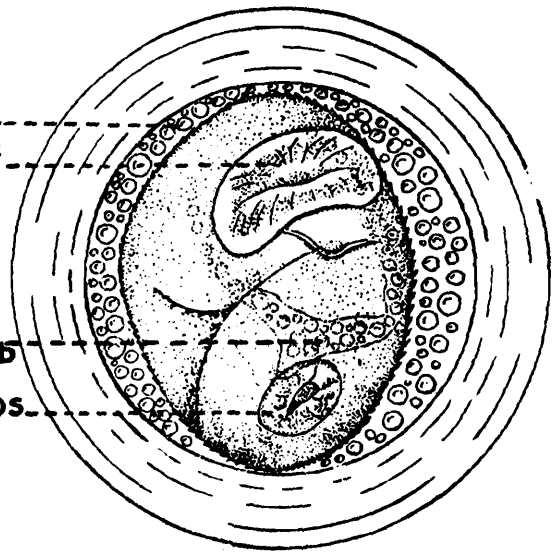

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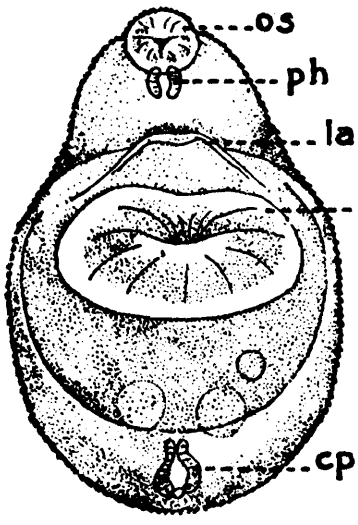

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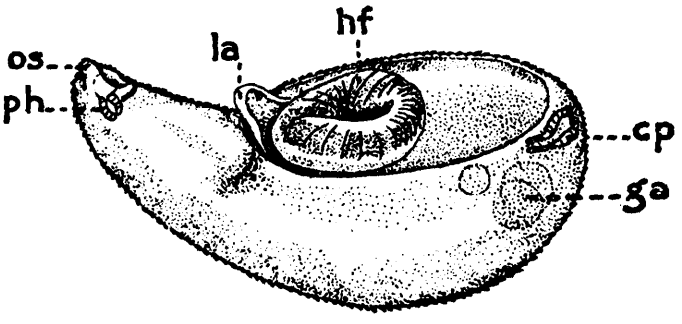

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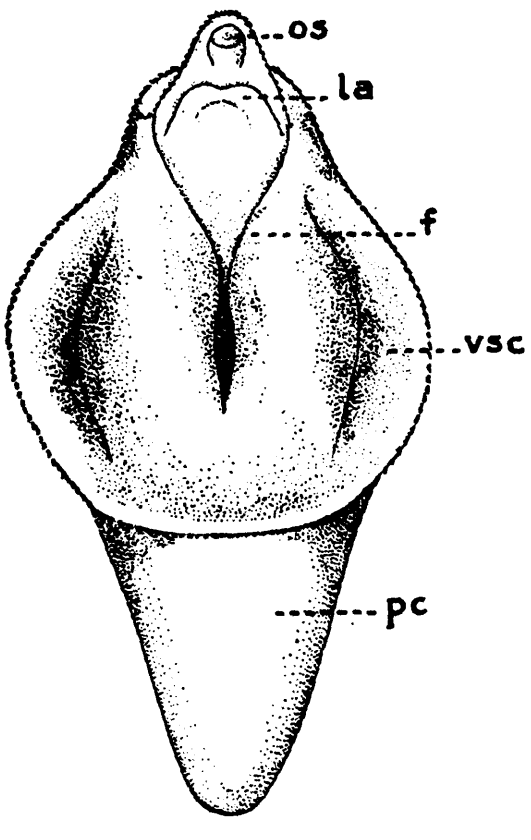

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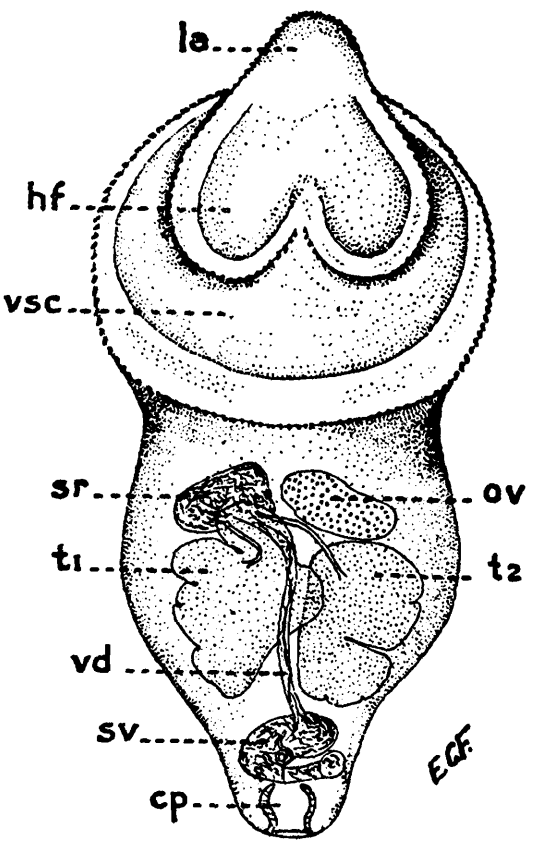

21

Asiatic Holostomes.

NOTES ON MOLLUSCS IN THE COLLECTIONS OF THE ZOOLOGICAL SURVEY OF INDIA (INDIAN MUSEUM), CALCUTTA.

By B. PRASHAD, *D.Sc., F.R.S.E., Zoological Survey of India, Indian Museum, Calcutta.*

(Plate XXII.)

I. ON A NEW SPECIES OF THE GENUS *PYRULA* LAMARCK.

For several years preceding the Great War the work of the Surgeon Naturalist on the Royal Indian Marine Survey Steamer "Investigator" was mainly confined to littoral and sub-littoral faunas in comparatively shallow waters, and the exigencies of the survey work did not permit of a great deal of trawling in the deeper areas. Thanks to the zeal of the Surgeon Naturalists in charge, however, the few opportunities for deep-sea trawling that occurred were never missed, and on one of these rare occasions the beautiful new species of *Pyrula*, described below, was collected. About the end of the Survey Season 1913-14, and on its return journey to Bombay the Agassiz Trawl on board the "Investigator" was used for dredging in depths of 180-167 fathoms on the 26th of April, 1914 in the Laccadive Sea (Station 611, 9° 34′ 18″ N. 75° 37′ 48″ E. to 9° 35′ 36″ N. 75° 36′ 54″ E.). In addition to other forms a fine series of living specimens of the new species of *Pyrula*, described below, was obtained.

I have great pleasure in dedicating this new species to my chief, Major R. B. Seymour Sewell, I.M.S., who, previous to his appointment as the head of the Zoological Survey of India, was the Surgeon Naturalist on board the "Investigator," and who has done so much towards filling up the gaps in our knowledge of the fauna of the Indian Seas.

Smith in 1894[1] revised the recent species of the genus *Pyrula* Lamarck, and published a critical account of the literature on the various species. It is not necessary, therefore, to refer to the earlier work on the genus, but it may be noted that there seems to be no justification for the change in the spelling of *Pyrula* to *Pirula*, as Smith has done.

It is also of interest to note here that I have compared the specimens of my new species with those of all the recent species in the collections of the Zoological Survey of India (Indian Museum), Calcutta, the British Museum (Natural History), South Kensington, London, and the Paris Museum, and have no doubt as to the species being an undescribed one.

The species *Pyrula sewelli* is of special interest in that it was found at a depth between 180-176 fathoms, and in view of the fairly large series of specimens having been obtained in a single trawl, there can be no question as to the species being an inhabitant of these great depths.

---

[1] Smith, *Journ. Malacol.* III, pp. 64-69 (1894).

Unfortunately, except for *P. investigatoris* Smith,[1] which was obtained "Off Ganjam Coast, east coast of India, in 98-102 fathoms," there are no records as to the exact depths at which the other species of this genus are found.

Pyrula sewelli, sp. nov.

(Plate XXII, figs. 1, 2, 4.)

Shell pyriform, moderately thin ; spirally ribbed, ribs flat and narrow, distinctly though only slightly raised, of a darker colour than the interspaces, which latter are much broader than the ribs ; interspaces often with a single thin thread-like rib running in the middle of each, parallel to the ribs themselves ; vertical ribs distinctly marked, but not so well developed as the spiral ridges, the shell surface as a result appears under a moderate magnification to be tessellated or cut up into squarish or rectangular areas. Vertical lines of growth distinct, often taking on the form of low varices. Shell whorls 6, increasing rapidly, distinctly swollen ; spire consisting of 4½-5 whorls of which 2-2½ are formed by the smooth and horny protoconch. Aperture elongated, rather narrow, a little over $\frac{5}{6}$th of the total length of the shell, anteriorly produced into a rather narrow almost straight canal ; columellar margin nearly straight ; outer lip sharp. Colour light brownish with the interspaces distinctly white, and without any other colour patches on the surface, inner surface shining white.

Measurements of the shells (in millimetres).

	Holotype.					
Total length	89·9	80	79·4	66	66·5	63·4
Maximum diameter	44·1	41·8	39·2	33·4	36·5	35·3
Height of the aperture	77·9	71·7	67·8	55·2	60·8	55·5
Maximum diameter of the aperture	27·3	22·6	22·2	18·2	18·1	18·1

Locality.—Laccadive Sea, in 180-167 fathoms on a bottom consisting of sand, sandy mud and shells.

Holotype.—No. M. $\frac{12573}{2}$ in the collections of the Zoological Survey of India (Indian Museum), Calcutta. Paratypes No. M $\frac{12574-83}{2}$.

Remarks.—*P. sewelli* is allied to *P. investigatoris* and with it forms a distinct group from amongst the recent species, in which the spire is high and distinctly raised. It differs from the latter in the shell being much narrower with the body-whorl much less swollen, the aperture narrower with a longer and nearly straight canal with hardly any curvature, the columellar margin similarly straight and more prominent sculpture. On Plate XXII, figs. 1-5 I give figures of the two species with portions of the outer surface of the shells of the two species magnified 15 times to show the exact differences in their sculpture.

---

[1] Smith, *Ann. Mag. Nat. Hist.* (6) XIV, p. 367 (1894). A wood-cut of this species was published by Wood-Mason and Alcock in the same Journal, Vol. VI, p. 15 (1891), and excellent figures of the Type were later published in the "Illustrations of the Zoology of the R. I. M. S. S. "Investigator," Mollusca, pl. vi, figs 2, 2a (Calcutta, 1897).

II. On a New species of the Genus *Ena* from Chitral.

Mr. G. H. Tipper, Superintendent, Geological Survey of India, made a small collection of land and freshwater molluscs in Chitral in 1923. The few specimens of the genus *Limnaea* from this collection were dealt with by Annandale and Rao[1] in their revision of the Indian Limnaeidae, and I propose publishing here the description of a new species of the genus *Ena*, Turton, and belonging to the subgenus *Subzebrinus* Westerlund. For the new species I propose the name *Ena* (*Subzebrinus*) *tipperi* in honour of the collector.

Ena (Subzebrinus) tipperi, sp. nov.

(Plate XXII, fig. 6.)

Shell distinctly umbilicated, fusiform; dull white, irregularly striated with feeble more or less vertical striae or low ridges, whorls 9; protoconch consisting of 2½ smooth, polished whorls of a horny colour; whorls slightly convex, increasing rapidly in size; body-whorl slightly oblique, about half the height of the spire. Spire subconoidal; suture shallow. Aperture slightly oblique, ovate; margins continuous over the parietal wall; peristome expanded and markedly reflexed, anterior and outer margins regularly curved, columellar margin slightly slanting; umbilicus narrow.

Measurements of the shells (in millimetres).

	Holotype.					
Length . .	31·0	29·9	30·8	29·4	26·8	27·3
Maximum diameter . . .	8·9	9·2	8·2	8·8	8·9	8·5
Height of the aperture .	11·8	11·4	12·1	11·2	11·0	10·6
Maximum diameter of the aperture . .	8·5	8·2	7·8	8·7	7·5	8·0

Locality.—Chitral, on the road from Naguar to Utsun (alt. *ca.* 4,000 ft.), common on bushes.

Holotype.—No. M $\frac{12\cdot7}{2}$ and paratypes in the collections of the Zoological Survey of India (Indian Museum), Calcutta.

Remarks.—*Ena* (*Subzebrinus*) *tipperi*, sp. nov. is allied to *E.* (*S.*) *longstaffi* Gude[2] from Samana Tsuk, near Upper Kurram Valley, N. W Frontier Province, India, but differs in the form of the shell, the aperture and the relative sizes of the whorls. I have compared the specimens of the new species with that of the types of *E.* (*S.*) *longstaffi* and other allied species in the British Museum (Natural History), S. Kensington, London, and in the Indian Museum collections, and have no doubt as to the species being a new one.

III. On a sinistral specimen of *Pila globosa* (Swainson).

In my recent revision of the Indian Ampullaridae[3] I included a few notes on two sinistral specimens of *Pila globosa* (Swainson) from the

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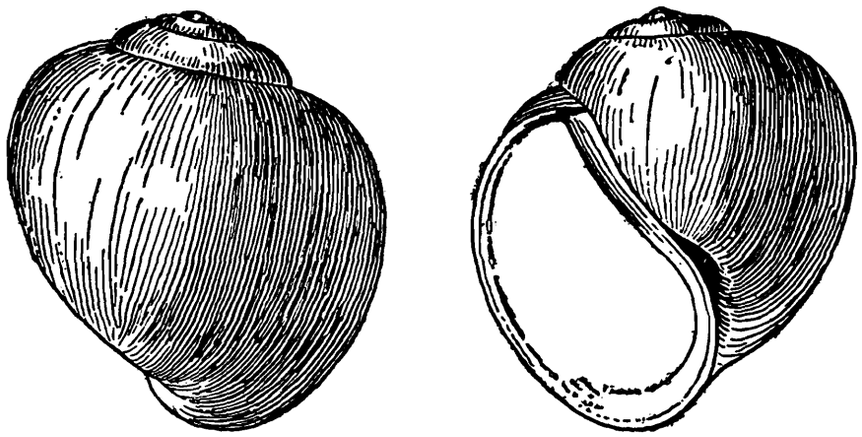
[1] Annandale & Rao, *Rec. Ind. Mus.* XXVII, pp. 137-189 (1925).
[2] Gude, *Faun. Brit. Ind. Mollusca*, II, pp. 246, 247, fig. 91 (London, 1914).
[3] Prashad, *Mem. Ind. Mus.* VIII, p. 73, pl. xiii, figs. 10, 11 (1925).

collections of the Zoological Survey of India, and published photographs of the two shells. The two specimens, as was remarked, formed the types of Nevill's subvar. *sinistrosa*[1] One of the specimens is from the old collections of the Asiatic Society of Bengal, Calcutta, and bears the locality label " Mauritius," while the second was collected by Dr. John Anderson from the Royal Botanical Gardens, Sibpur near Calcutta. The provenance of the former specimens is undoubtedly wrongly noted. As is well known, no members of the family Ampullaridae are found in Mauritius[2], and the shell in question is quite similar to the Sibpur shell. It may also be noted here that it does not resemble any of the known species of the sinistral African genus of the family *Lanistes* Montfort. Under the circumstances I agree with Nevill that it is a sinistral shell of *P. globosa*, and is an Indian shell.

Another shell absolutely identical with the above mentioned specimens has recently been presented to the Zoological Survey of India by Mr. D. D. Mukherjee, Assistant in the Zoological Survey of India.



TEXT-FIGURE 1.—Sinistral specimen of *Pila globosa* (Swainson) from near Barrackpore, Calcutta. Natural size.

The shell was collected by him from a shallow pond near Barrackpore at a distance of about 12 miles from Calcutta, in 1922. Unfortunately the operculum of the specimen is missing. Its measurements in millimetres are :—Total height 40·5, maximum diameter 39·2, oblique height of the mouth 31·5 and maximum diameter of the mouth 17·6.

It is also of interest to note that these records, together with the one of a sinistral specimen of *Pila virens* (Lamarck) in the paper cited above (Prashad, *loc. cit.* pl. xiv, fig. 3), are the only ones of the occurrence of sinistral shells in the normally dextral genera of the family Ampullaridae, and that none were recorded by either Sykes[3] or Ancey[4] in their lists of sinistral forms.

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[1] Nevill, *Hand-List Moll. Ind. Mus.* II, p. 2 (Calcutta, 1885).

[2] In this connection see for example, Germain, " *Faune Malacol. Terr. et Fluv. des Iles Mascareignes.*" (Angers, 1921).

[3] Sykes, *Proc. Malacol. Soc. London* VI, pp. 269 270 (1905).

[4] Ancey, *Bull. Sci. France Belgique* XL, pp. 187-205 (1906).

EXPLANATION OF PLATE XXII.

All the figures reproduced are from direct untouched photographs of the shells.

Pyrula sewelli, sp. nov.

Figs. 1, 1a.—Two views of the Holotype of the species. Natural size.

Figs. 2, 2a.—Two views of a half-grown shell of the same species. Natural size.

Fig. 3.—*Pyrula investigatoris* Smith. Photograph of the type-shell as seen from the dorsal surface.

Fig. 4.—*Pyrula sewelli*, sp. nov. Photograph of the sculpture on the body-whorl ×15.

Fig. 5.—*Pyrula investigatoris* Smith. Photograph of the sculpture on the body-whorl ×15.

Fig. 6.—*Ena* (*Subzebrinus*) *tipperi*, sp. nov. Two views of the Holotype. Natural size.

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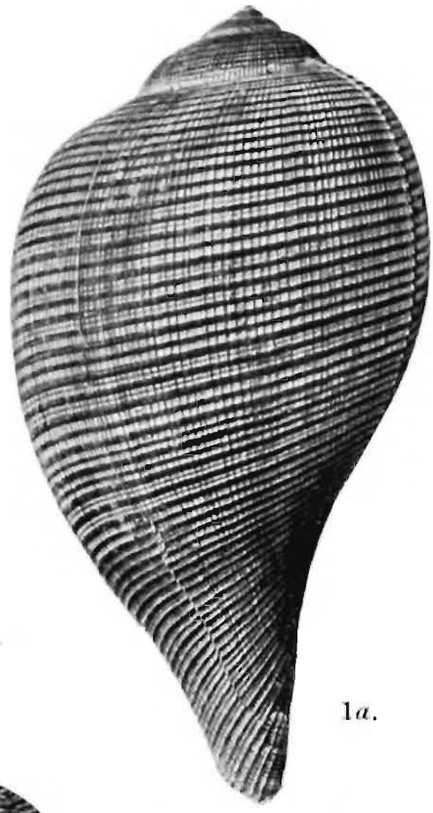
6a.



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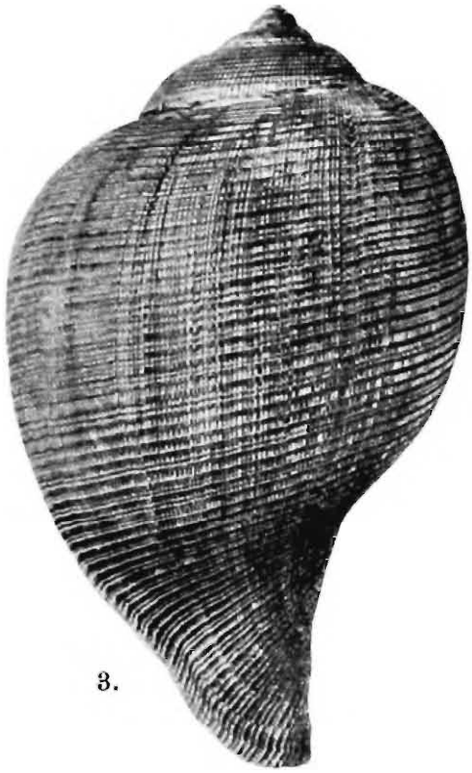

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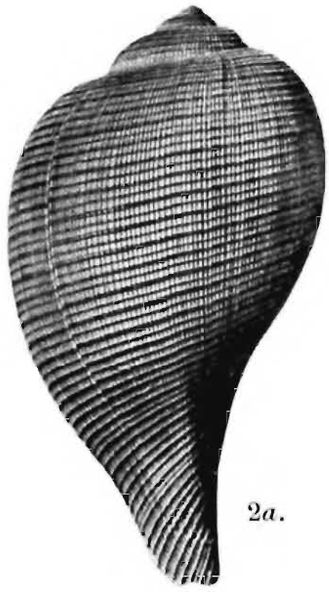

2a.

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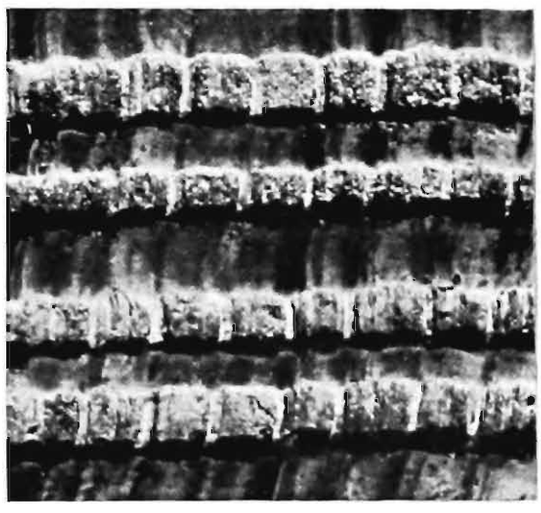

5.

Subodh Mondul Photo.

NEW INDIAN MOLLUSCS.