

**A TAXONOMIC STUDY OF THE
CULICOIDES BITING MIDGES (CERATOPOGONIDAE :
DIPTERA : INSECTA) OF WEST BENGAL**

THESIS SUBMITTED FOR THE DEGREE OF
DOCTOR OF PHILOSOPHY (SCIENCE)
OF THE
UNIVERSITY OF NORTH BENGAL
1985

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FOREWORD

The thesis treats the taxonomic and distributional aspect of the biting midges belonging to the genus Culicoides Latreille, family Ceratopogonidae, order Diptera, in the State of West Bengal, India. The study was started in 1979, at the Post-graduate deptt. of Zoology of Darjeeling Government College and since September 1980, following transfer of the author of the thesis, it was shifted to the Zoology Deptt., Presidency College, Calcutta, and was carried out there till completion. A total of 79 species of Culicoides was studied of which 18 were described in the thesis as new to science. The previously known species were re-examined, opinions available on them in literature or by correspondence with the experts were checked and their present status as due was shown in the thesis alongwith additional distribution data where necessary. Also described in the thesis were the keys to identification of the species of different groups and subgenera into which the described species of Culicoides of West Bengal now could be accommodated. The subgeneric and Group-level features were reviewed in the thesis carefully combining the available data both from literature and from conclusions made in course of the present study. Species synonymisation, subgeneric interchange and proposition of new species-groups were found necessary in several instances and those

were incorporated in the thesis as necessary. A systematic table showing the valid species of Gulicoides of the State of West Bengal, India, was also provided in the thesis.

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of Entomology of the University of Maryland, U.S.A., for kindly providing reprints of their work and other pertinent literature. I am also indebted to Dr. B. K. Tikader, Director, Zoological Survey of India, Calcutta to Dr. P. K. Choudhuri, Reader, Zoology Deptt., Burdwan University and to Dr. B. C. Majumdar of Habra S. C. College for various technical help and other courtesies, and I express my gratitude to all the personalities in Calcutta, Darjeeling and elsewhere who either helped me in collecting/procuring Ceratopogonid samples in course of my study or assisted me in many other ways, prominent of whom were: (1) Dr. P. K. Saha, formerly a teacher fellow at Presidency College, Calcutta, and now the Head, Zoology Deptt., Krishnagar Govt. College, (2) Dr. (Mrs.) S. Ghose, formerly a teacher fellow at Presidency College, Calcutta, and now a researcher in the Yale University Medical Centre, U.S.A., (3) Dr. Balaran Dasgupta, of Zoology Deptt. of A. N. College, Calcutta, (4) Dr. A. K. Roy, Asstt. Professor of Zoology, Hooghly Mohsin College, (5) Mr. S. Alam, of Zoology Deptt. of Presidency College, Calcutta and (6) Mr. B. Samanta, Artist. My thanks are also to Mr. T. S. S. Anjaneyulu, Regional Director, Regional Meteorological Centre, Govt. of India, Calcutta, for kindly providing me with the meteorological and edaphic data of the State of West Bengal, used in the thesis. Finally I record my appreciation to the University Grants Commission, New Delhi, for providing me with some financial assistance for completing my present study.

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I. I N T R O D U C T I O N

INTRODUCTION

The genus Culicoides, erected by Latreille in 1809, is included in the family Ceratopogonidae (= Helicidae), suborder Nematocera, order Diptera of the class Insecta. For many years it was treated as one of the genera of the subfamily Ceratopogoninae. Recognition of the family Ceratopogonidae, raising the subfamily into a family taxon, was made in 1917 and since then the status has been maintained in all pertinent literature including the common entomological books (Korror and DeLong, 1963; Imms, 1977). Today, the family Ceratopogonidae includes 78 valid genera and subgenera within its 4 subfamilies on a global basis (Wirth et al. 1974)

The blood-sucking insects of the genus Culicoides are commonly referred to as biting midges or gnats and are well known to the laymen in different parts of the world in various colloquial names, such as, "machhri" in Bombay area, "outki" in Assam and Bengal area of India (Patel, 1921), "jejens" in South America (Hill, 1947), "brulots" in French Canada and "punkies" and "no-see-ums" in the forested regions of America (Jannback, 1965). The genus has recently received much attention from the taxonomists all over the world because of its species having economic importance as disease vectors and pests of man and farm animals (Korror et al. 1965, 1974; Braverman and Galun, 1973).

A) Economic importance of Culicoides

Acclaimed as a menace in pestiferous forms retarding development of the otherwise favourable resorts in many coastal areas for their avid anthropophilic and zoophilic habits in many species, the biting midges throughout their distributional range may act as vectors of filarial worms, malarial-like protozoans and some groups of viruses affecting man as well as the domesticated and wild animals and birds. Their ability to inflict some damage in fruit-cultivation, to affect pollination of tropical economic plants and their occasional entomophagous habit add to their further importance.

The females of many species of the three ceratopogonid genera - Culicoides, Lesiochelea and Leptocnemea, are long known to feed on warm-blooded vertebrates (birds and mammals). Culicoides may be more troublesome than mosquitoes and according to an observation (Hopkins, 1952), a biting rate by them exceeding 2000/hour can be withstood only for a few minutes. Such a rate can be responsible for entomophobial symptoms in man although the usual effects of a bite show up as provisional local swelling with irritation. They have long been suspected as the possible arthropod-vectors of many a disease-agents. Thus, Patton (1913) quotes Townsend who connected some Lesiochelea as carriers of "Utah" (= Oriental sore) in the South Andean. Culicoides have been suspected as vectors of a type of child fever in Korea and a type of horse-sickness in South Africa and China.

In India, their abundance in damp, humid conditions characteristic of the Kala-azar belts was noted and Roy (1928) observed that a Leishoeles species (referred by him as "Eye-flies") had an identical seasonal incidence with that of "Naga" sore and epidemic conjunctivitis. That a fever of several days' duration may follow from Culicoides bites in many tropical and subtropical countries was long suspected and Hoye and Lee (1961) from their observations in Australia concluded that these insects were potential vectors of diseases between flying fox, bird and man in that country.

The real incrimination of biting midges as the vectors in nature started with Sharp (1927, 1928) who showed that a Culicoides was the carrier of the human filarial worm, Acanthocheilonema peratans in West Africa. A complete development of the worm Haemonella azardi in a Culicoides, fed on infected persons in West Indies, was noted by Buckley (1938) who also incriminated a Culicoides as the vector of cattle onchocerciasis in Malaya. Earlier, Steward (1933) in England showed spread of this disease in horses through Culicoides and the same was confirmed to be the case in France as well by Maignous (1952). Natural microfilarial infection in Culicoides in Algeria, Mexico, Venezuela and in Thailand were recorded by Sargent et al. (1933), Dampf (1956), Miran et al. (1952) and Causey (1938) respectively. Bergner and Jachewski (1968) traced the development of a filarial parasite of monkeys in Culicoides in

Taiwan, while Robinson (1971) showed a Gulicoides as the vector of the filarial parasite Chandlerella of grackles. The transmission of malaria like protozoan parasites by Gulicoides were reported thus : Akiba (1960) incriminating G. arakawa as the vector of Leucocytozoon of chickens in Japan, Fallis and Bennett (1961) detecting some Gulicoides as the vector of Haemaphysalis (= Parahaemaphysalis) of crows and finches in Canada and Graham et al. (1961, 1962) showing conclusively two Gulicoides as vectors of Hepatozoon parasites in African monkeys. There have been further reports of such cases from these countries, and in India, Dasgupta and Pal (1976) report natural infection of malarial oocysts in Gulicoides of Darjeeling. The status of transmission of such nonviral disease agents by Gulicoides in recent years is reviewed very aptly in recent years by Greiner and Bennett (1977) and by Lourie et al. (1977).

The most important vectorial role played by Gulicoides seems to be in their dissemination of several viral bodies, that of the blue-tongue diseases of sheep and cattle populations in South Africa, the New World countries and Australia being the long-known focal point in this respect (Du Toit 1962; Price and his collaborator 1954 and 1963; Foster et al. 1968; Bowne 1973; Bowne et al. 1964; Lee et al. 1974; ~~Price~~ Dyce and Standfast 1979), and it was found that the specimens of the schultzei-ovata complex, G. peregrinus and G. notani which occurred widely in India

harboured the ET virus in Israel (Braverman and Galun, 1973), Nigeria (Lee *et al.* 1974) and Australia (St. George *et al.* 1984). The spread of the buttonwillow virus by Culicoides in the U.S.A. was demonstrated by Reeves *et al.* (1970). The Culicoides species are also proven vectors of African horse sickness and it is presumed that the dispersal of these infected midges may have been responsible for spread of this disease from one to another country in different years including the case from Pakistan to India during 1960 onwards (Boorman 1979). It is also long suggested ~~that~~ that the Culicoides play a role in the transmission of viruses of feul-fox in Japan and of avian synovitis in the U.S.A.

From a scrutiny of literature, it appears that the habit of having a blood meal by female Culicoides from mammalian hosts is yet not known very critically though this habit is intimately connected with their role as transmitters of various disease agents in addition to their nuisance value in a locality. The haematophagous Culicoides show a fair amount of host specificity and the anthropophilic species of India were actoni, anopheles, flaviscutatus, macfiei, porocarpus, oxytarsus and varivialis. Some of these avidly attacked cattle populations and other warmblooded mammals and birds. From several spot studies, in and around Calcutta, Dasgupta (1964) contended that C. anopheles and C. palifer do not readily attack such hosts while C. circumscriptus was anthropophilic

and the readily zoophilic species were schultzei, peracrinus, innoxius and turgidus, which also fed on man in captivity.

B) Review of literature on Indian Culicoides and scope of the present study.

The first taxonomic study on the Culicoides fauna of India started with Kieffer (1910) who later enriched our knowledge by a few more contributions (1911 a-b; 1913; 1914). This was followed by Patton (1913), Dover (1921), Edwards (1922), Smith (1929), Mukerji (1931), Smith and Swaminath (1932), and Macfie (1932). After a long interval, Sen and Das Gupta (1959a) attempted a comprehensive study on the Indian Culicoides mainly on the basis of materials collected in and around Calcutta. Their study furnished descriptions of many a new species, redescriptions of a few known species and corrections of some previous taxonomic errors. Das Gupta (1962b, 1963 a-c) and Wirth and Hubert (1959) described a few more species from other parts of India and Sikkim. Das Gupta (1964) in a revisionary study of the ceratopogonid fauna reported the existence of 42 valid species of Culicoides within the territory of India and Sikkim. Subsequently, Majumdar and Dasgupta (1972) exploring to some extent the eastern India locations, found that 70 species of Culicoides were extant in India. They found 28 of these as new to science and they could accommodate all known Indian species of Culicoides in 23 species groups under 11 subgenera, 14 of the species groups being newly proposed by them.

The intensive taxonomic studies on Culicoides of many Afro-Asian countries, and Australia and adjoining countries made during all past years by various specialists abroad had a both direct and indirect bearing on any appraisal of Culicoides of India since it was becoming increasingly clearer that several species did have either a continuous distribution range or sporadic, isolated occurrence in two or more countries. Thus the recent work on African Culicoides by Clastrier and his collaborators (1959-'61), Dipeolu and his collaborators (1974-'77), Eoornan and his collaborators (1979) and Cornet and his collaborators (1970 and '74) were indispensable; similarly important were the findings on (i) the Culicoides of Arab countries, Egypt and Israel in the middle east by Negaty and Moray (1959-'61), by Navaal and her collaborator (1965-'71), and by Braverman and his collaborators (1970-1977), (ii) the Culicoides fauna of South east Asiatic countries including China by Wirth and his collaborators (1959-1981), by Chen and his collaborators (1962 & 1982), Chu (1977), by Kitacka and his collaborator (1963-1974), by Cho (1974), by Wada (1977-1979) and by Kitacka (1963 & 1983), (iii) the Culicoides of Soviet Asia by Gutsevich (1975) and (iv) the Culicoides of Australia by Dyce and his collaborators (1979-1983). Many valuable reappraisals of previously known species extent in several countries including India were reported in these papers as a result of which our confusions about synonymic cases were dispelled to some extent, and our knowledge about the species distribution increased.

In this connection, the monographic works of earlier times on Culicoides of various zoogeographical realms were also found necessary and liberal consultation of Carter *et al.* (1920,1921), Edwards (1926), Causey (1938), Lee and Reye (1953), Arnaud (1956), Anosova (1957), Wirth and Blanton (1959), Tokunaga (1959), Gutsorich (1959,1960), Campbell and Pelham-Clinton (1960), Delfinado (1961), Jamnback (1965) etc., were also necessary.

As for having the basic conception of the species-groups and the subgenera of Culicoides, the work of Fox (1948), Vargas (1953 (a-b, 1973a-b), Wirth and his collaborators (1959-1974), Delfinado (1961) etc. are useful. A checklist of Oriental Culicoides by Wirth (1973) aptly sums up the position though the unpublished data in this respect by Hajumdar and Dasgupta (1972) showing Indian species at that time could not be included in the same.

From a perusal of literature reported above it appears that there has been a tremendous progress in the general taxonomic knowledge of Culicoides on global basis during last twelve years from now. The genus Culicoides is known to be represented by more than 1500 species, over 50 species groups and 22 subgenera. The old conception of the subgenera and the species groups underwent a substantial change requiring reappraisal of the Culicoides fauna of various countries. The same necessitated inter-subgeneric and inter-species group changes and consequent rearrangement of the

valid species of a country including redefinition of species characteristics in many cases, and while such exercises were taken up by the concerned scholars in respect of most of the countries elsewhere, the case for India practically remained stagnant at 1972 level, as per the work of Majumdar and Dasgupta (1972). It was thus necessary to re-assess the data of these authors in light of recent findings elsewhere on various sections of Culicoides and to work out modifications as due. Moreover, as was evident from literature, the explorations of Culicoides fauna in different parts of India were still in a rather elementary stage, the diverse ecosystems in different parts of the country hardly being yet touched in any worthy manner. So the scope for undertaking repeated explorations and study of Culicoides collected thereby was always there. It was amidst such backdrops that the present study involving fresh explorations of Culicoides in the State of West Bengal, India was undertaken. The richness of the Culicoides speciation and their abundance in different parts of the study area justified not to cover more areas of India outside the State of West Bengal. It is presumed, species listed now as extant in the study area will be found fairly distributed in other parts of India as well; in that way, the present study will act as the latest available, updated taxonomic work of Culicoides of India for any future reference.

II. MATERIAL AND METHOD

MATERIAL AND METHODS

The present study is based on the imaginal forms of Culicoides biting midges, collected from different parts of West Bengal during the period 1978-1984, and on similar materials received by exchange and donations from some concerns, 1. Dr. A. V. Gusevich, Zoological Institute, Leningrad, U.S.S.R., 2. Dr. W. W. Wirth, U. S. National Museum, Washington, D.C., U.S.A., 3. Dr. Y. Braverman, Kirron Veterinary Institute, Israel, 4. Dr. D. H. Messeremith, Dept. of Entomology, University of Maryland, U.S.A., 5. Dr. P. Basu, All India Institute of Public Health and Hygiene, Calcutta, India, 6. Miss N. Jayalakshmi, Madras Veterinary College, Madras, 7. Dr. U. V. Shastri, Professor of Parasitology, College of Veterinary and Animal Sciences, MAU, Parbhani, Maharashtra, India, 8. Dr. J. N. Misra, Field Lab., R. & D. organization, Ministry of Defence, Govt. of India, Tezpur, Assam, India, at home and abroad, through the endeavour of my guide Dr. S. K. Dasgupta. Many specimens including types or paratypes of genus Culicoides were also received as contribution from the work of Dr. B. C. Majumdar of Sree Chaitanya College, Habra. My collections covered almost all districts of West Bengal and ^asubstantial portion was from Darjeeling, Bardwan and Calcutta districts and their surroundings.

A) Method of collection :

Several devices as follows were adopted in collecting Culicoides specimens from nature (after Dasgupta and his collaborators 1956-1972):

i. Light traps : The different types of light traps used during the present study were :

- i) Shinaurah light trap (Fig.1A) - designed by Banerjee and Dasu (1956), it is essentially a stationary device fixed on a stand equipped with the provisions for fitting to it an electric lamp of 100 to 200 watts or a 'Petromax'. The device enclosed in a glass case to avoid rains. The bottom of this device is a cylindrical glass/plastic jar where the trapped insects are collected. Glacial Acetic Acid was used as the killing agent in a trap.
- ii) Open-tray type light trap (Fig.1B) - this trap was used by Sinha Ray et al. (1969), in course of their collection work on biting midges of Darjeeling, it consists of two or three ordinary table lamps, each of 100-200 watts, with their head bent down to the water level in a metallic tray measuring 30 cm x 25 cm x 4 cm covered with a fine wire-net of 8 mesh per sq.cm., the water in the tray having traces of Glacial Acetic Acid as the killing agent in the trap. This type of light trap was operated in Darjeeling area.

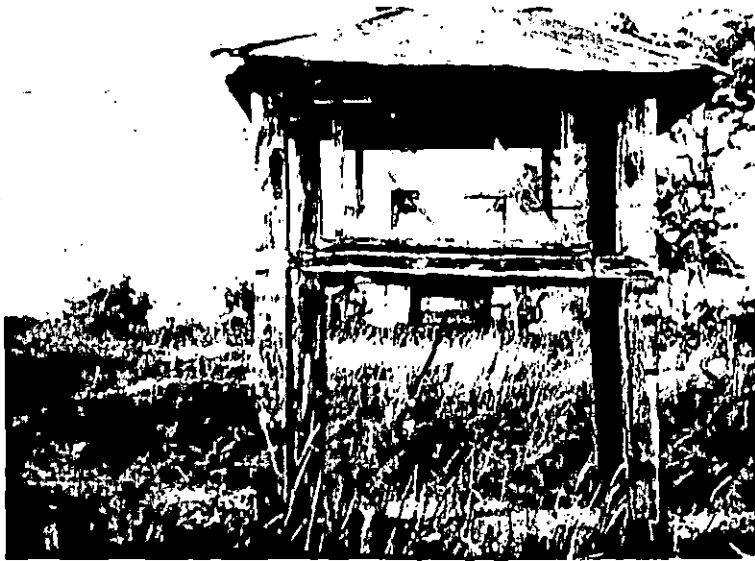


Fig. 1A : 'Chinsurah' light trap.



Fig. 1B : Open-tray type light trap.



Fig. 1C : Closed-cylinder type light-trap.

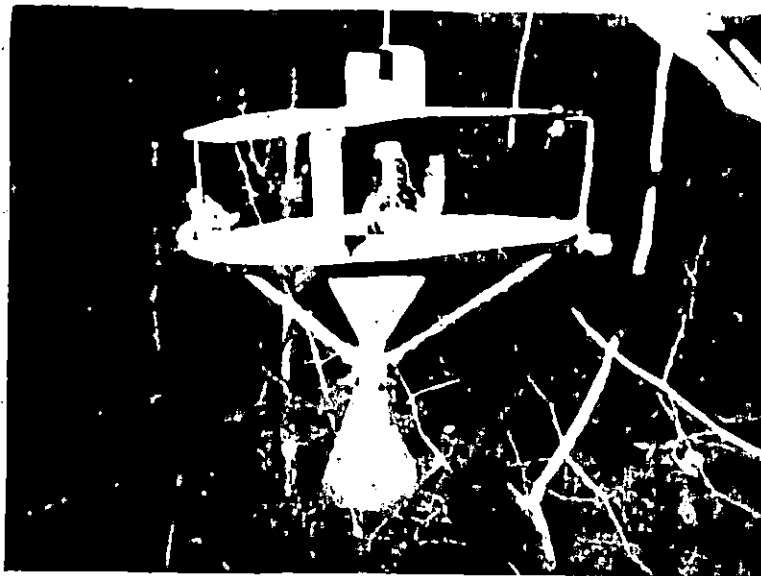


Fig. 1D : Disc-type open light trap.

- iii) Closed cylinder type light trap (Fig.1C) - designed by Dr. S. K. Dasgupta, it consists of a cylinder (30 cm. in length and 16 cm. in diameter) with 3-4 alternating rectangular-sized holes for letting out light-beams from light-source inside the top end of the cylinder. A detachable metallic lid at the bottom acted as receptacle for the trapped insects. It is specially used for collecting insects in dry condition. Sometimes liquid Paraffin was placed in the receptacle and insects were collected therein. This instrument is handy and easily movable. Collections by this type of light trap were made at Chinsurah, Bardwan, Raiganj and other places.
- iv) iv) Disc-type light trap (Fig.1D) - this type of light trap, adopted by Dr. B. Majumdar (1972), in his work on Colicoidae insects, consists essentially of two circular plates, each of 35 cm. diameter. The upper plate is provided with arrangements for fitting an electric lamp of high wattage and the lower part with a large hole through which a funnel is fitted to a collecting bottle containing chloroform-soaked cotton. This device is easily portable. Collections by this type of light trap were made at Habra, Sodepur and other places of the District 24-Parganas.



Fig. 1E : Site of collection at Darjeeling.

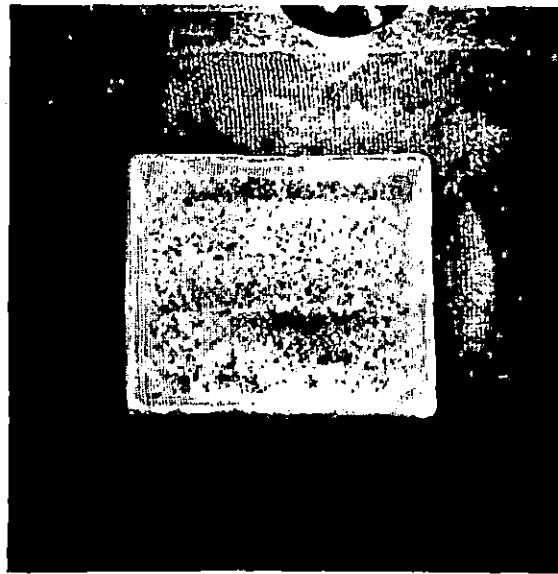


Fig. 1F : Light-trap collection at Pallaroad.

B) Sites and other data :

The light trap were operated in 65 localities (Fig.3) for 754 trap-nights in the districts of Bankura, Birbhum, Burdwan, Coochbehar, Calcutta, Darjeeling, Hooghly, Howrah, Jalpaiguri, Malda, Midnapur, Murshidabad, Nadia, Purnia, 24-Parganas and West-Dinajpur. Excepting Darjeeling, Calcutta and Burdwan, collections in other places were, however, stray and random. In those four districts of West Bengal of which six localities such as Calcutta, Darjeeling, Chinsurah, Habra, Palharoad and Raiganj, collections were made consistantly for a period from January to December each year during 1968-1981. An enormous number of specimens were assembled as a result of these repeated endeavours.

A total of 36,516 Gulicoides specimens could be collected combining the field collection made in course of the present work as well as specimens obtained from different concerns, mentioned above. The data of field collections were shown in tables 1-4.

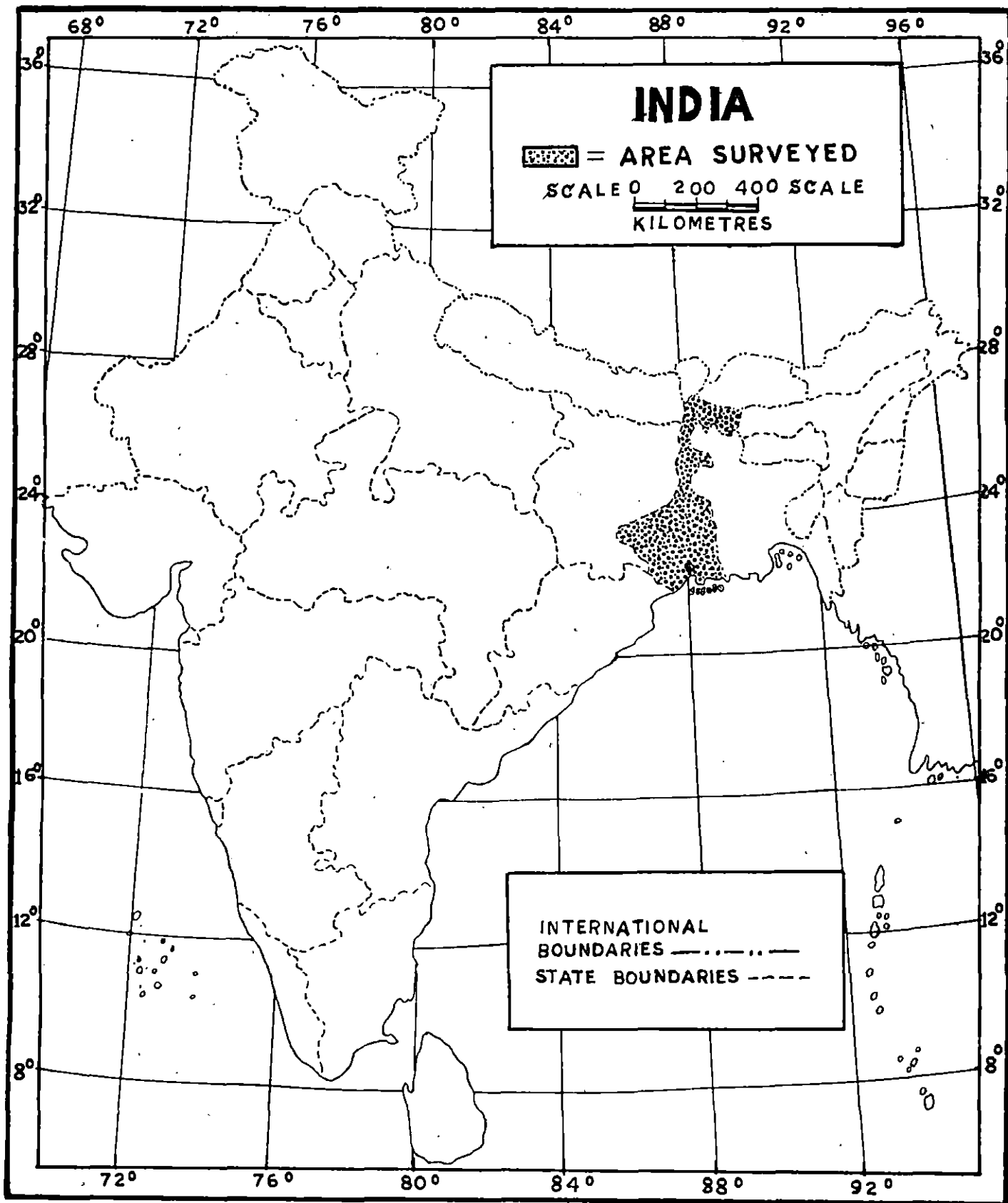


FIG.-2

MAP OF INDIA SHOWING THE LOCATION OF WEST BENGAL

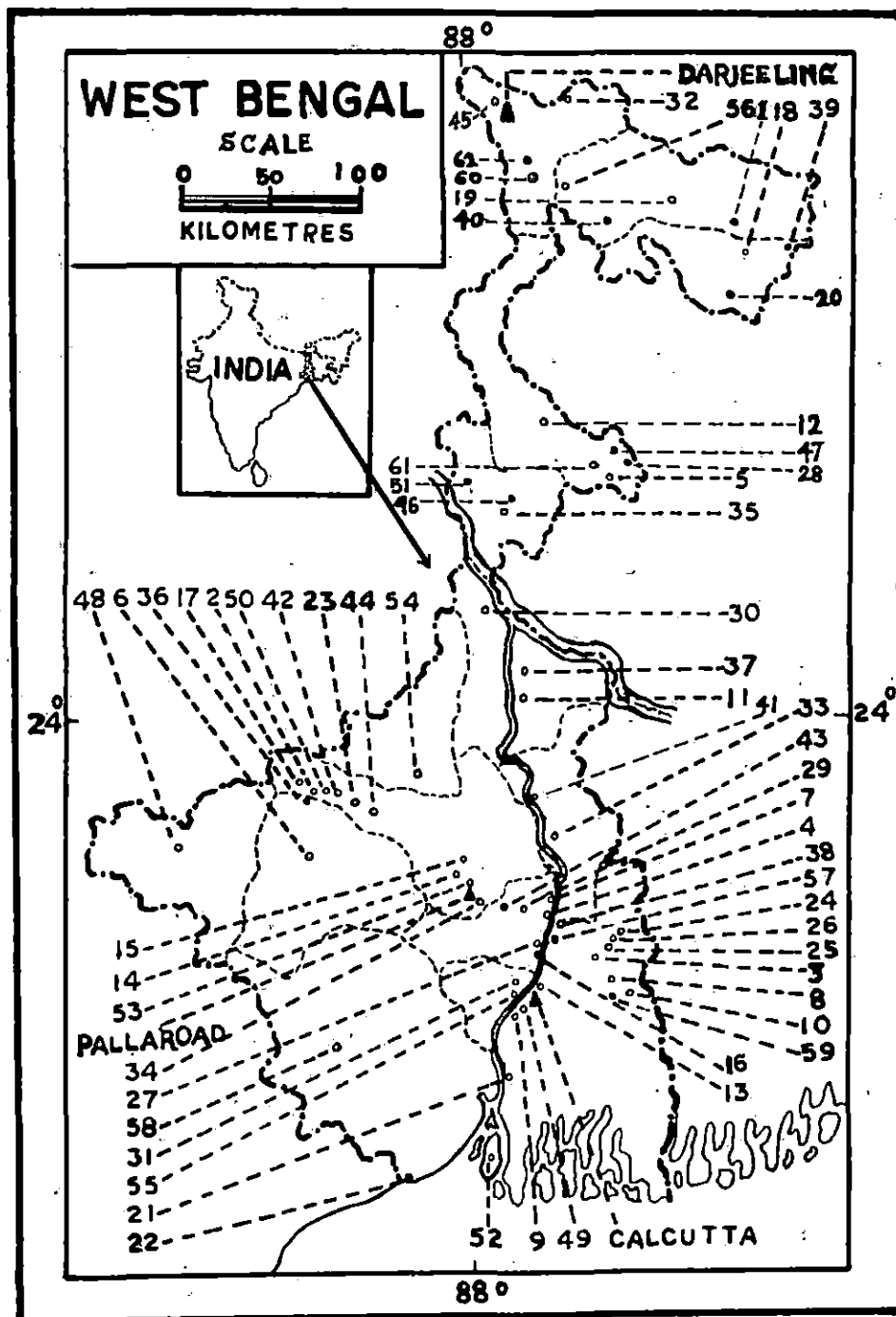


FIG-3

MAP OF WEST BENGAL SHOWING THE SITES OF TRAPPINGS

Explanation of Map of West Bengal (Fig. 3)
showing the sites of collection as follows:

1. Alipurduars
2. Aconsol
3. Ashoknagar
4. Bagati
5. Balurghat
6. Bankura Town
7. Bansbaria
8. Bashirhat
9. Batenagar
10. Berachampa
11. Berhampore
12. Bijnadpur
13. Bon Hooghly
14. Burdwan Town
15. Burdwan farm area
16. Chinsurah
17. Churulia
18. Coochbehar Town
19. Dhupguri
20. Dinhata
21. Diamond Harbour
22. Digha
23. Durgapur
24. Gobordanga
25. Guma
26. Habra
27. Hooghly Town
28. Hilli
29. Itachuna
30. Jangipur
31. Kadamtala
32. Kalliyong
33. Krishnanagar
34. Madanpur
35. Malda Town
36. Mejia
37. Murshidabad Town
38. Naihati
39. Nintijhar
40. New Jalpaiguri
41. Nokasipara
42. Ondal
43. Pandua
44. Panagarh
45. Pulbazar
46. Pandua
47. Patirem
48. Purulia
49. Rabindranagar
50. Raniganj village
51. Ratua
52. Sagar (Rakdwip)
53. Saktigarh
54. Santiniketan
55. Sibpur
56. Siliguri
57. Sodepur
58. Senakanla
59. Taki
60. Tindharla
61. Tapan
62. Tung

▲ Sites of constant collection

Table No. 1

Data of fixed light-trap collections at
Calcutta during 1980 - 1981

Collecting period	No. of collecting nights	Total Diptera	Total Ceratopogonidae	Total Culi- coidea	Average Culicoides per night (in no.)
May, 1980	4	60	35	24	3.5
June, 1980	6	90	39	18	3.00
July, 1980	8	98	46	33	4.12
August, 1980	2	30	16	8	4.00
October, 1980	7	1,212	510	272	38.50
November, 1980	3	1,265	625	248	82.60
December, 1980	5	1,520	782	190	38.00
January, 1981	9	125	25	9	1.00
February, 1981	10	899	270	44	14.40
March, 1981	9	1,475	618	192	21.33
April, 1981	11	414	190	102	9.27
Grand Total	74	7,088	3,156	1,030	

Table No. 2

Data of fixed light-trap collections at
Barjeeling town during 1968 and 1978-1979

Collecting period	No. of collecting nights	Total Diptera	Total Ceratopogonidae	Total Culicoides	Average Culicoides per night (in no.)
April, 1968	1	224	2	0	0.00
May, 1968	24	7,401	476	157	6.54
June, 1968	20	20,616	2,923	1,890	94.70
July, 1968	21	68,117	9,690	3,511	167.19
August, 1968	21	34,275	3,322	1,200	57.14
September, 1968	16	36,316	4,207	1,112	69.50
April, 1978	11	444	188	64	5.81
May, 1978	9	2,555	506	102	11.33
June, 1978	6	4,691	892	399	66.50
July, 1978	4	10,353	633	240	60.00
April, 1979	12	201	40	5	3.33
May, 1979	27	2,307	901	201	7.64
June, 1979	11	3,435	987	388	35.27
Grand Total	183	1,90,935	20,767	9,269	

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Table No. 3

Data of fixed light-trap collections at
Palharoad (Burdwan St.) during 1978-1980

Collecting period	No. of collecting nights	Total Diptera	Total Coxatopogonidae	Total Culicoides	Average Culicoides per night (in no.)
November, 1978	2	36	16	4	2.00
December, 1978	2	23	6	0	0.00
May, 1979	5	72	34	17	3.40
July, 1979	4	420	260	81	20.25
October, 1979	2	824	266	88	44.00
November, 1979	1	254	92	32	32.00
April, 1980	3	360	66	24	8.00
May, 1980	3	57	24	8	2.66
June, 1980	4	1,377	403	131	32.75
August, 1980	2	599	291	93	46.50
September, 1980	1	491	169	54	54.00
October, 1980	3	1,090	351	105	35.00
November, 1980	3	1,840	282	97	32.33
Grand Total	35	7,443	2,260	734	

Table No. 4

Data of random light-trap collections at different places of West Bengal during 1966-1968 and 1977-1981

Collecting sites	Collecting period	Collecting nights(No.)	Collected Calicosides(No.)
1. Alipur Duara, Dist. Jalpaiguri	December, 1972	3	5
2. Asansol, Dist. Burdwan	September, 1962	3	67
3. Ashokenagar, Dist. 24 Parganas	April-Nov., 1966	7	103
4. Bagati, Dist. Hooghly	September, 1966	1	6
5. Balurghat, Dist. West Dinajpur	July, 1966	1	3
6. Bankura Town, Dist. Bankura	October, 1966	3	41
7. Banchberia, Dist. Hooghly	August, 1966	4	142
8. Banchirhat, Dist. 24 Parganas	October, 1966	1	11
9. Bantanagar, Dist. 24 Parganas	October, 1966	7	45
10. Berachampa, Dist. 24 Parganas	October, 1966	1	37
11. Berhampur, Dist. Murshidabad	September, 1967	2	4
12. Buniadpur, Dist. West Dinajpur	September, 1968	3	21
13. Bonhooghly, Dist. 24 Parganas	November, 1966	2	4
14. Burdwan Town Dist. Burdwan	April-Sept., 1967	27	106

contd...

Table No. 4 contd.:

Collecting sites	Collecting period	Collecting nights (No.)	Collected Culicoides (No)
15. Burdwan farm area, Dist. Burdwan	April-Sept., 1967	11	421
16. Churrulia, Dist. Burdwan	August, 1967	5	143
17. Chincurah, Dist. Hooghly	July-August, 1966	27	2,071
18. Coochbehar Town, Dist. Coochbehar	November, 1966	4	71
19. Bhuguri, Dist. Jalpaiguri	November, 1967	6	227
20. Dinhat, Dist. Coochbehar	November, 1967	1	9
21. Diamond Harbour Dist. 24 Parganas	March, 1967	1	16
22. Digha, Dist. Midnapur	December, 1967	2	0
23. Durgapur, Dist. Burdwan	April-Dec., 1967	7	72
24. Gobardanga Dist. 24 Parganas	April, '66-March '67	31	3668
25. Guna, Dist. 24 Parganas	October, 1966	4	31
26. Habra, Dist. 24 Parganas	August '66-July '67	141	14,706
27. Hooghly Town, Dist. Hooghly	August, 1966	2	3
28. Hilli, Dist. West Dinajpur	April, 1967	2	5
29. Itachuna, Dist. Hooghly	April-December, 1967	8	188
30. Jangipur, Dist. Murshidabad	September, 1967	1	49

contd.....

Table No. 4 contd.:

Collecting sites	Collecting period	Collecting nights (No.)	Collected Culicoides (No.)
31. Kadamtala, Dist. Howrah	July, 1966	2	5
32. Kalimpong, Dist. Darjeeling	April, 1966	2	110
33. Krishnanagar, Dist. Nadia	October, 1966	4	40
34. Madanpur, Dist. Burdwan	April-December, 1967	4	66
35. Maldah Town Dist. Maldah	October, 1968	2	133
36. Kajia, Dt. Bankura	April-December, 1968	9	48
37. Murshidabad Town, Dist. Murshidabad	November, 1966	1	4
38. Naihati, Dist. 24-Parganas	June, 1966	4	11
39. Wintijhar T.E., Dist. Coochbehar	November, 1966	2	8
40. New Jalpaiguri, Dist. New Jalpaiguri,	July, 1966	4	8
41. Nakaopara, Dist. Nadia	June, 1967	2	36
42. Ondal, Dist. Burdwan	April, 1967	2	19
43. Pandua, Dist. Hooghly	November, 1966	4	5
44. Panagerh, Dist. Burdwan	April, 1967	1	2
45. Pandua, Dist. Maldah	October, 1966	1	4
46. Patiran, Dist. West Dinajpur	February, 1967	3	64
47. Pulbasar, Dist. Darjeeling	April, 1978	1	100

contd.....

Table No. 4 contd.:

Collecting sites	Collecting period	Collecting nights (No.)	Collected Caliscoiden (No.)
48. Purulia Town, Dist. Purulia	November, 1967	2	26
49. Rabindranagar, Dist. Calcutta	September, 1966	3	26
50. Raniganj Dist. Burdwan	April-December, 1967	7	105
51. Ratus, Dist. Maldah	August, 1967	2	64
52. Sagar, Dist. 24-Parganas	March, 1984	2	66
53. Saktigarh, Dist. Burdwan	April, 1980	8	16
54. Santiniketon Dist. Birbhum	November, 1966	3	13
55. Sibpur, Dist. Howrah	November, 1966	1	1
56. Siliguri, Dist. Jalpaiguri	May-June, 1969	15	473
57. Sodapur, Dist. 24-Parganas	May '80-April '81	24	520
58. Sonakania, Dist. Midnapur	November, 1968	2	26
59. Taki, Dist. 24-Parganas	October, 1967	3	1106
60. Fındharia, Dist. Darjeeling	April, 1978	1	8
61. Tayan, Dist. West Dinajpur	June, 1979	1	10
62. Tunga, Dist. Darjeeling	April, 1978	2	70
Total		442	25,483

It should be mentioned that 36,516 Culicoides collected by light trappings over years were daily examined and sorted out into species those belonged to either in dry state or in alcohol (70%) preserved state or in slide mounts. While the majority could be sorted out duly as per synoptic tables provided in the present thesis, a minor fraction of the collected specimens defied identification for various reasons. While we rejected outright such specimens as were found badly damaged after collection, it was seen that the fraction defying identification belonged either to variable category of specimens, or stray 'aberrant' forms or 'general' forms. As male-female collation in such cases was not found feasible and as there was lack of a consistence in the variability, it was preferred to keep such specimens collected now out of the present study. Only, more collections at the very locations of their availability may make it possible in future to categorise these 'difficult' specimens.

As for the specieswise quantum of the identified material, a further separate list/table and concomitant significance of the same were not provided now since the same were actually beyond the scope of the present study. It is, however, clarified that an indication of the numerical abundance of the species expressed in the text by commenting as "a scarce element", "less common species", "very extensively distributed", "limited distributions", "very uncommon in its place of occurrence", "a common form", "most abundant" element", "prevail abundantly", "colaterally distributed", "very wide geographical distribution" etc. were a pointer to the turn-up frequency of the species in our collection.

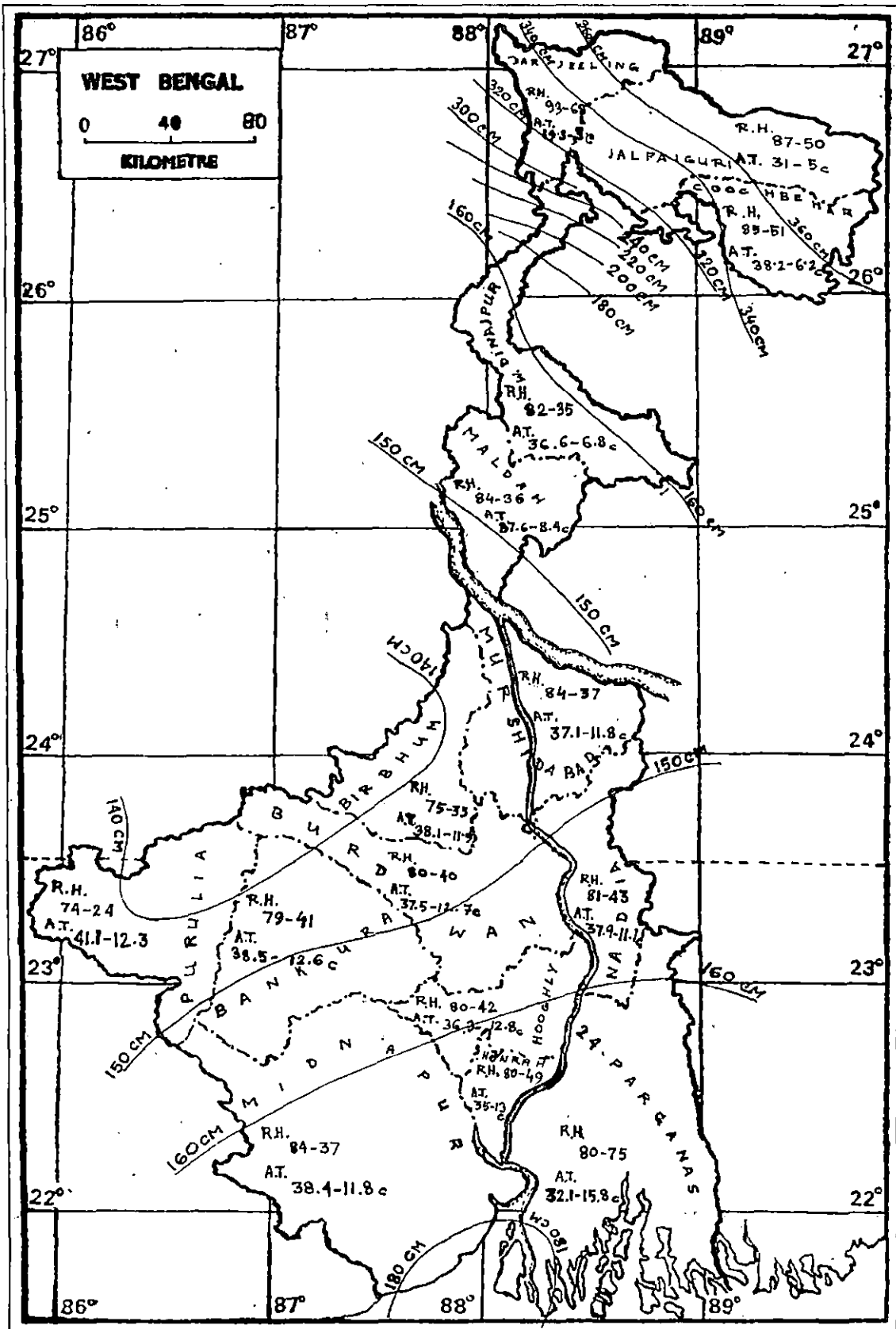


FIG-4 Composite Map of West Bengal showing districtwise relative humidity (R.H.) temperature range (A.T.) and average annual rainfall (CM)

In the text, for a species, a reference was only made to such samples which actually were based in preparing illustrated, taxonomic descriptions of the species.

The locations cited in above tables and also in subsequent pages of the thesis are all shown in the physical map of the State of West Bengal, India (Figs. 2-3).

The 65 locations whose Culicoides specimens are now studied belonged to 16 districts of the West Bengal State. The edaphic and topographic nature alongwith average annual rainfall and range of temperature and relative humidity in those districts were illustrated in figs. 4-5. It would follow from the data provided therein that the State of West Bengal altitudinally is highly variable, being over 2000 m height from sea level in subhimalayan region of Darjeeling in the north to almost zero level in the coastal areas in the south. On basis of edaphic factors, the state is divisible to some 9 zones, from extreme north southward the zones being - Hill soil area (major part of Darjeeling district and minor part of Jalpaiguri district), Lateritic area (major parts of Birbhum and Malda districts and minor parts of Bankura, Burdwan and Midnapur districts), Red soil area (major parts of Bankura and Burdwan districts, and minor part of Birbhum, Malda, Midnapur, Murshidabad and West Dinajpur districts), Marshy soil area (minor part of Malda, Nadia and 24-Parganas districts), Deltaic and saline soil area (major part of 24-Parganas district and minor part of Midnapur

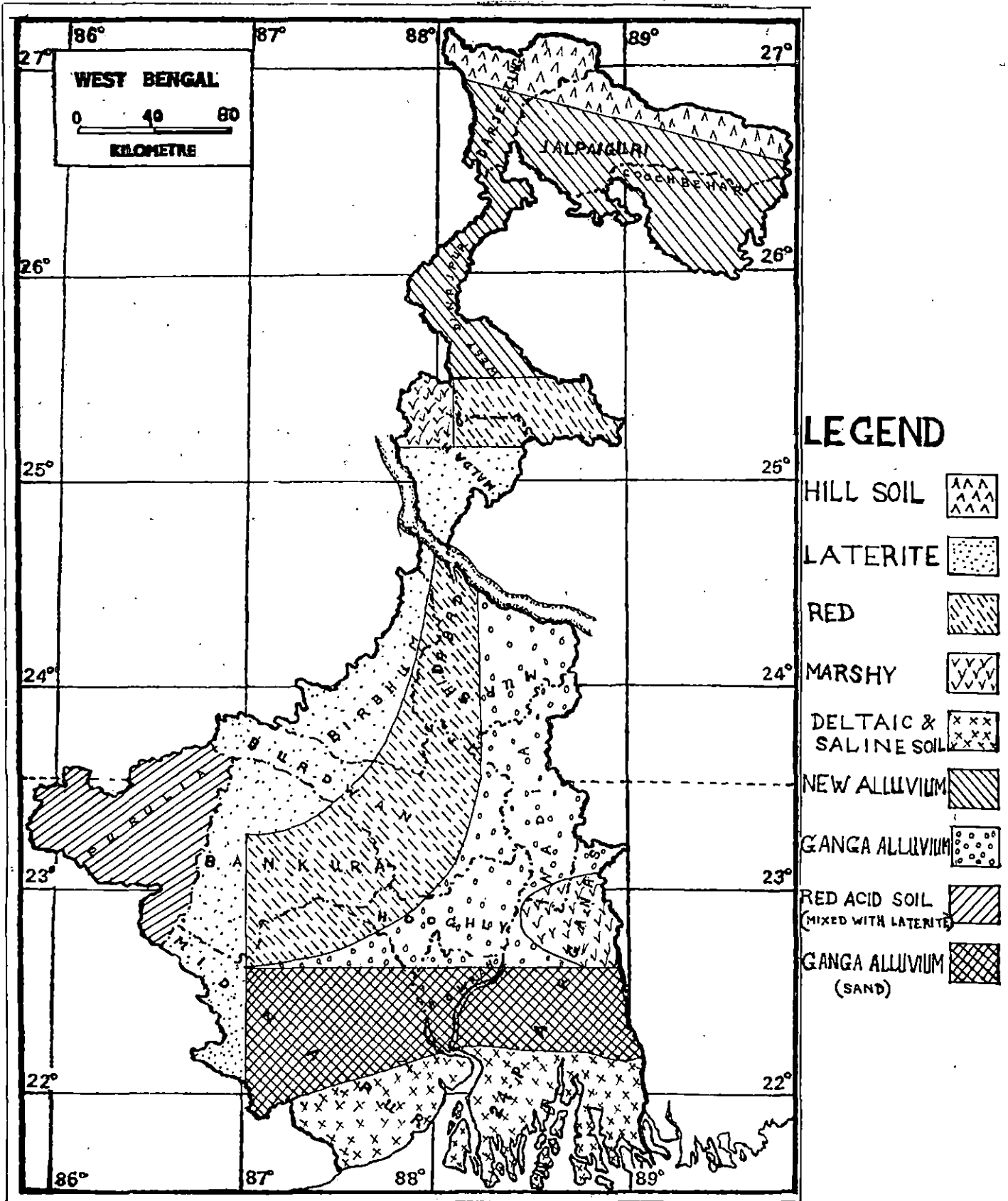


FIG-5 Soil map of West Bengal.

district), Low alluvium area (major part of Jalpaiguri and West Dinajpur districts, whole of Coochbehar district and minor part of Darjeeling district), Genoa alluvium area (major part of Hooghly and Nadia districts, and minor part of Burdwan, Howrah, Midnapur, Murshidabad and 24-Parganas districts), Red acid soil area mixed with laterite (whole of Purnia district) and Genoa alluvium sand area (root of Calcutta, Howrah, Midnapur and 24-Parganas districts). Large forest areas prevailed in Bankura, Coochbehar, Darjeeling, Jalpaiguri and 24-Parganas districts.

C) Procedures and terminologies :

In the present study, the Culicoides populations of the subgenus Erithacoides were given the emphasis since in past studies (Dasgupta and his collaborators 1956-'72), it received scant or no attention. The species belonging to that subgenus found as new to science were all fully described.

In preparing the specimens for taxonomic examination and study, the method of Wirth and Blanton (1959) has been mainly followed. The specimens were first placed in the saturated solution of pure phenol in absolute alcohol and kept in a warm oven for 12-15 hours for clearing. The treatment made the specimens clear and somewhat transparent. The well cleared specimens were then taken on micro-slides, one on one slide, and a drop of mountant previously prepared by making a homogeneous mixture of canada balsam and phenol in equal

proportion was put over it. The specimen was then suitably dissected into several parts, the female body into wings, head, legs, thorax and abdomen, and the male body into wings, genitalia and the rest. The dissected parts were suitably oriented in the mountant and a cover-slip was placed over it. The prepared slides were then left in hot oven for complete drying and hardening of the mountant. Additional canada balsam was added from time to time according to the necessity to fill up the gaps in the slides, if any.

The unmounted specimens were preserved in 70% alcohol in the laboratory where the work was executed.

The morphological terminologies used in the text were based on Campbell and Felham - Clinton (1960), Jamnback (1955) and Wirth & Blanton (1970), are fully explained in figs. 6-7. For convenience, the term "antennomere" or "segment" has been used for each of the 15 division of antenna and "palpomere" for a segment of the maxillary palp. Abbreviations H T C and A P used in the text meant hind tibial comb and apicolateral processes respectively. The technical terms and usages used in the text are amplified below :

Antennal ratio (AR) - is the ratio obtained by dividing the combined length of the distal five antennomeres by the combined length of the preceding eight antennomeres.

Costal ratio (C R) - is the value obtained by dividing the distance from the basal arculus to the end of the costa by the wing length.

Palpal ratio (L/W) - is the length to greatest breadth ratio of the third segment of the maxillary palp.

Proboscis to head index ratio (P/H) - is the value obtained by dividing the distance from torus to the tip of labrum-epipharynx by the distance from the interocular seta-base to the torus.

Tarsal ratio (T R) - is the value obtained by dividing the length of first tarsomere by the length of the second tarsomere of a hind leg.

The wing length has been measured from the basal arculus to the wing tip and spermatheca from one end to other excluding the sclerotized portion of the duct ("neck") and its maximum width was taken as its breadth. Measurements have usually been made of a series of 10-15 specimens when available and as far as possible presented as "Mean (minimum-maximum, n = number of specimens measured)".

All figures has been drawn with the help of a camera lucida keeping error constant. To avoid clumsiness, aedeagus and parameres of males have been drawn separately.

The illustrations provided now in the thesis were of all the species described as new to science. The new species of Majumdar and Dasgupta (1972) which were re-studied now were now reviewed in important aspects only and illustrations of selected parts of the same were given. Of the previously described species, only the salient features were reviewed but no illustrations of those were given now as literature were replete with the same.

The types of the new species and other materials studied are in the custody of the Zoology Department (Entomology Section) of Presidency College Museum (abbreviated as "Cs PCZM). Representative specimens including paratypes, when available, will be sent in due course to the various depositories at home and abroad including the Zoological Survey of India in Calcutta, the U.S. National Museum in Washington, the British Museum (Natural History) in London and the Leningrad Zoological Institute, U.S.S.R.

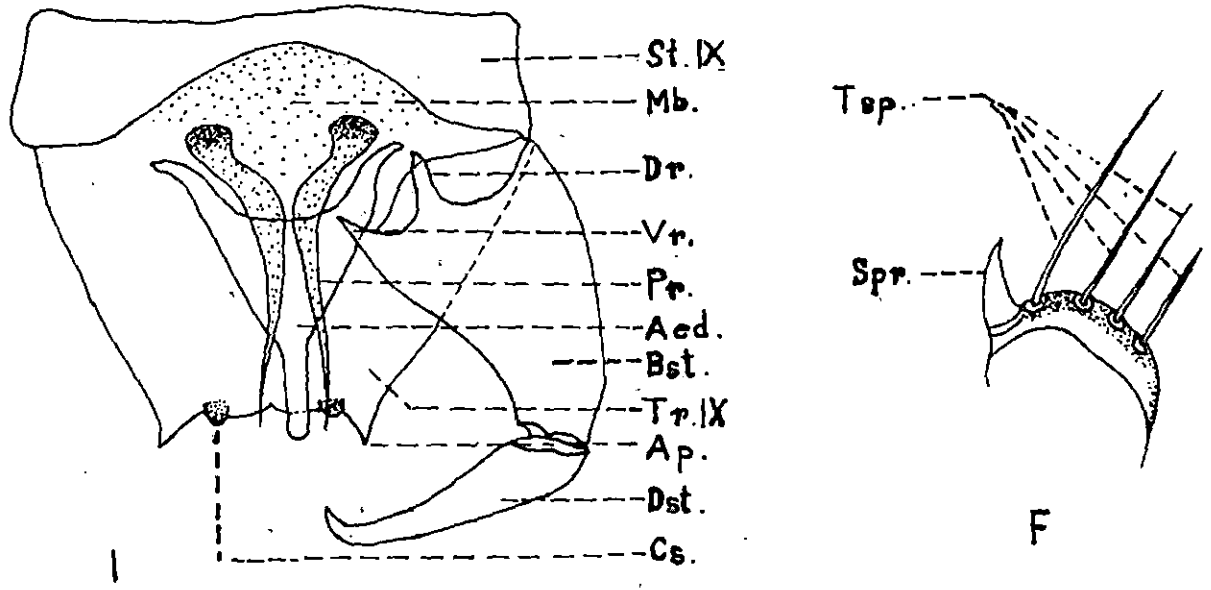
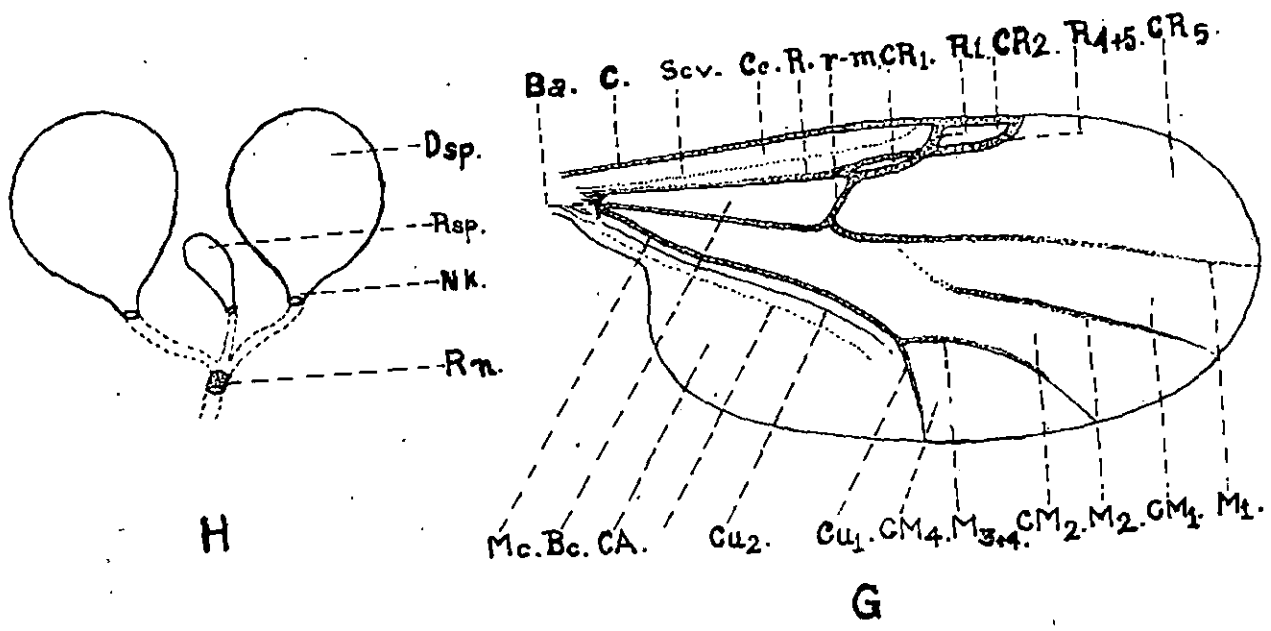


FIG-7

Explanation of figs. 6 and 7

Morphological structures of Fulicoides

- A. Dorsal view of the head of a female
- B. Antenna of a female
- C. Maxillary palp of a female
- D. Dorsal view of the thorax with halteres of a female
- E. A female leg.
- F. Tibial comb of hind leg of a female
- G. A female wing
- H. Spermathecal apparatus of a female
- I. Ventral view of a male genitalia

Abbreviations

A ₁	- First anal vein	Cu ₂	- Vein Cu ₂
Aed.	- Aedeagus	Cx	- Coxa
Ant.	- Antenna	Dr.	- Dorsal root
Ap.	- Apicolateral process	Dep	- Developed spermatheca
Ba	- Basal arculus	Dist.	- Dististyle
Bc	- Basal cell	Fcc	- Fronto-clypeus
Bst	- Basistyle	Fr	- Femur
C	- Costal vein	Fvx	- Frontovertex
CA	- Anal cell	H	- Distance from interocular seta-base to torus
Cc	- Costal cell	Hkb	- Halter knob
Ce	- Compound eye	Hp	- Humeral pit
Cl	- Tarsal claw	Hra	- Humeral area
CN ₁	- Cell M ₁	Hst	- Halter stem
CN ₂	- Cell M ₂	Iob	- Interorbital bristle
CN ₄	- Cell M ₄	Lb	- Labium
CR ₅	- Cell R ₅	Lbr-ep	- Labrus-epipharynx
Csa	- Caudoscutal area	M ₁	- Vein M ₁
Csp	- Caudoscutellar pit	M ₂	- Vein M ₂
Cs	- Circus		
Cu ₁	- Vein Cu ₁		

M ₃₊₄	- Vein M ₃₊₄	Ra	- Radial sector
Ml	- Ventral membrane	Rap	- Rudimentary spermatheca
Mc	- Mediocubital vein	Sbr	- Scutellar bristle
Md	- Mandible	Scm	- Scutum
Mvt	- Median vitta	Scv	- Subcostal vein
Mxb	- Maxillary blade	Slm	- Scutellum
Mxp	- Maxillary palp	Spr	- Spur
NK	- Neck (spermathecal neck)	Spt	- Sensory pit
Oc	- Ocellus	St.IX	- Sternum IX
P	- Distance from torus to tip of labrum-epipharynx	Sts	- Sensory tuft (= distal sensory coelocornica)
Pr	- Paramere	Ta	- Tibia
Psm	- Post scutellum	Tr.IX	- Tergum IX
R	- Radial vein	Trm	- Torus
R ₁	- Vein R ₁	Trr	- Trochanter
R ₄₊₅	- Vein R ₄₊₅	Ts	- Tarsomere I-V
CR ₁	- Cell R ₁	Top	- Spines on hind tibial comb
CR ₂	- Cell R ₂	Vr.	- Ventral root
r-m	- Radio-medial cross-vein	W	- Width of segment III of the maxillary palp
Rn	- Ring		

III. TAXONOMIC ACCOUNT

Subgenus Avaritia Fox, 1959, 39: 218

(Type of the subgenus : Ceratoroson obscuratus Meigen, by original designation).

General characters : Small to medium sized, darkish. Wing usually with faint markings, second radial cell pale distad, base of cell M_4 dark and without pale area bordering veins M_{3+4} and Cu_1 while in cell M_2 anterior to medio-cubital fork, no pale spot visible; macrotrichia scanty; costa short. Third palponere usually slender with a small, round sensory pit and its part distal to the pit not narrow. Eyes contiguous. Antenna with distal sensilla coeloconic confined to segments III, XI - XV. Spermathecae sclerotised, developed two and a third rudimentary one often visible. Male genitalia variable; tergum IX usually without any apicolateral processes; parameres separated, each with unknobbed bases and filamentous tip directed laterad; aedeagus usually with short arms, shallow basal arch and slender stem having finely rounded caudal tip; basistyllic roots both well developed.

The 14 species of Culicoides belonging to subgenus Avaritia are found to occur in the State of West Bengal and these may be placed under 3 known groups of species within the subgenus. The important characters of these 3 groups are as follows :

Actoni Group : small sized forms; wing with pale spots in cell R_5 prominent; macrotrichia in wing surface sparse to none; third palpomere with shallow sensory pit; legs pale with vague colour banding; HTC of 4 - 5, first from apex usually the longest; male genitalia with tergum IX often with a conical caudomedial depression.

The Actoni Group was first proposed by Majumdar and Dasgupta (1972) under subgenus Cocasta Poey to accommodate 4 Indian species known to them. They included the group under subgenus Cocasta basing on near total shaded state of second radial cell of the species which they considered under the group. It now seems more correct to treat the Actoni Group under subgenus Avaritia in defiance of the point on shaded state of the second radial cell since the same seemed to show some variation.

Autumnalis Group : wing usually with small pale spots which, if extensive, are never interconnected and no broad paleness at wing base; pale spot at r-m crossvein does not extend below medial vein level.

The Autumnalis Group was first proposed by Majumdar and Dasgupta to accommodate the three little known Indian species, and the same is being maintained now pending further knowledge in the matter.

Orientalis Group : wing usually with extensive pale spots which are often variously interconnected; large pale spot at wing base extended in anal cell as a longitudinal streak almost down to anal

margin; pale spot at r-m crossvein stretches below medial vein level to cell M_2 .

Some 10 species described previously from several parts of West Bengal may be placed under the Orientalis Group which, however, seems to be a heterogeneous one. Kieffer's species, C. himalayae, C. celestiae and C. odiosus, do not fit here very aptly, but pending our further knowledge of them, these three species are provisionally included here. The general features of all the species concerned are reviewed below.

A). ACTONI GROUP OF SPECIES

Culicoides actoni Smith

Culicoides actoni Smith, 1929, 17: 255. Sen and Dasgupta, 1959, 92: 622 (notes). - Delfinado, 1961, 33:634 (record, description). - Majumdar and Dasgupta, 1972:75 (records, redescription; NEW SYNONYMY C. minutus Sen and Dasgupta).

Culicoides impercentus Dasgupta, 1962: 538 (Syn. of C. actoni Smith, det. by Dyce and Wirth, 1983: 224).

Female : Scutum yellowish brown with darkish anterior but no evident colour pattern; scutellum with 1 central and 2-4 lateral bristles. Legs pale brown with no distinct bands; HTC of 5, first from spur longest. Wing brownish with two distinct large pale spots in cell R_5 - one touching apex of second radial cell and the other

apical angle touching wing margin, the intervening darkish area between these two spots being as a thick column; other spots less distinct but small; macrotrichia stray few near margin of cell M_1 to M_4 . Haltere pale. Spermathecae two developed, moderately sclerotized, subequal and subglobular with short sclerotized necks; a third rudimentary often missing though prominent ring visible.

Male genitalia : sternum IX with a deep caudomedial excavation; tergum IX with depression of caudal margin somewhat conical but no apparent apicolateral processes; stylites usual with opposably curved, prominent basistylitic roots; aedeagus massive, conical with short arms and stem, the stem being slender its caudal tip finely rounded; parameres each with thickly knobbed base and simple, bare filamentous caudal tip ending in a point.

Distribution : India (Burnihat of Assam,, parts of West Bengal); Borneo, Cambodia, Sri Lanka, Malaya, Philippines, Thailand, Australia and New Guinea.

Specimens examined : 10 females, 8 males collected by S. K. Dasgupta at light trap during 1957, 1960-1963, from several parts of West Bengal; in and around Calcutta, Chinsurah, Naihati, Habra, Gobardanga, Siliguri and Darjeeling (all in slide-mounts, 2 of co-type status).

Comments : The present species is a very extensively distributed species occurring in the Australian mainland to Indian subcontinent in the West. It appears that due exploration will locate its presence in many other States of India. Dyce and Wirth (1983) examining allotype male and cotype female of C. minutus Sen and Dasgupta opined that these belonged to C. actoni Smith. Previously, Dyce (1979) relegated New Guinea samples of C. orientalis Macfie, worked out by Tokunaga (1959, 1962) as actually belonging to C. actoni Smith.

Calicoidea definitus Sen and Dasgupta

Calicoidea definitus Sen and Dasgupta, 1959 : 622.

Female : scabella coeloconica on antennomeres III, VII - IX, XI - XIV. Wing brownish with about 12, mostly large, pale spots - at base, at r-m, two each in cell R_5 , M_1 , M_2 and anal cell; second radial cell almost totally dark-shaded; macrotrichia stray few in distal part of most cell-surfaces. Haltere knob pale. Legs dark brown with subbasal and subapical pale bands on femora and tibiae; HTC of 4, first from spur longest. Spermathecae two developed, sclerotised, subequal and ovoidal with narrow sclerotized necks, a third rudimentary and short ring visible.

Male genitalia : sternum IX with a shallow caudomedial depression, tergum IX without apicolateral processes though its caudal margin depressed conically; aedeagus and parameres typical of the Actoni Group.

Distribution : India (Dum Dum, around Calcutta, West Bengal).

Specimens examined : 1 male, 1 female slide-mounts, of paratype status; collected by S. K. Dasgupta from Dum Dum (around Calcutta), West Bengal, during March 1958 at light trap.

Comments : Large sized pale spots in wings, 4 spines in hind tibial comb, sensilla caeloconica also on antennomeres VII - IX in females are some of the specialities which distinguish the present species amongst the known Avaritian Culicoides. It seems to be rather a less common form in nature.

B) AUTUMNALIS GROUP OF SPECIES

Culicoides autumnalis Sen and Dasgupta

Culicoides autumnalis Sen and Dasgupta, 1959 : 628.

Female : unknown.

Male : brown scutum with blackish patch at both ends, scutellum with 4 bristles and like postscutellum uniformly dark. Wing brown with some 6 pale spots at r-m, at apex of second radial cell distal third of the cell being included in the spot, at apical angle in cell R₅, at cell M₄ and two at anal cell; cell M₁ appears almost totally pale and a pale streak extends through cell M₂; macrotrichia on radius and its branches only. Haltere pale. Legs brown with subapical pale bands on hind femora and middle tibia, other femora

and tibiae with subbasal and subapical pale bands; HTC of 5, first from spur longest. Genitalia - Sternum IX with a shallow caudomedial excavation, its corresponding tergum bereft of epiclateral processes or any depression of caudal margin that appears rather flat; aedeagus massive, subconical with short and slender arms and stem, caudal tip of stem finely rounded; parameres each with thickly knobbed base, its caudal tip filamentous bare.

Distribution : India (Dum Dum and Baguihati, around Calcutta, West Bengal).

Specimens examined now : 2 slide-mounted males (1 of Paratype status), collected from Dum Dum and Baguihati areas in the suburb of Calcutta at light trap by S. K. Dasgupta during September 1957 and March 1958.

Comments : Dyce and Wirth (1983) after examining a paratype male of the present species, in slide-mount, observe, "..... specimen mounted with terminalia tilted. Hind margin of 9th tergite bilobate, not "rounded" as described". They were unable to distinguish it from C. brevivalvis Delfinado, 1961, widespread in the Oriental Region and extending to northern Australia, and they proposed retention of C. brevivalvis as valid, taking C. autumnalis Sen and Dasgupta as a nomen dubium.

In their description of C. autumnalis, Sen and Dasgupta observe that tergum IX of male genitalia is "without notch", though the corresponding sternum bears a caudomedial depression. This is confirmed in a subsequent observation (Dasgupta, 1964), as found also in course of the present investigation. Pending discovery of females of C. autumnalis, it seems reasonable to treat the two species in point as separate. C. autumnalis is described validly and conforming to taxonomic practice as applicable; therefore, inability to locate its holotype or any distortion in slide-mount/s of its paratype cannot invalidate it. It appears to us that it is probably very closely related to C. brayinialis and the related species, but it is distinct, limited in distribution and is a scarce element of the ceratopogonid fauna in its place of occurrence.

Gulicoides dudumi Sen and Dasgupta

Gulicoides dudumi Sen and Dasgupta, 1959 : 628.

Female : unknown.

Male : scutum dark brown. Third palpomere medially swollen with a post-medial, shallow sensory pit. Wing brownish with several vaguely marked pale spots - at r-m, two each in cell R_5 to M_4 and 1 in anal cell; macrotrichia none in wing surface. Haltere knob pale. Legs brown with subbasal pale bands on femora and narrow subapical pale bands on tibiae; HFC of 5, first from spur longest. Genitalia - sternum IX with a medial shallow excavation in its caudal margin,

tergum IX without apicolateral processes though its caudal margin bears medially a shallow indentation; other genitalic parts typical of Acteni Group though paramere tip with a few spines.

Distribution : India (Duz Dun and Baguihati around Calcutta, West Bengal); other parts of Southeast Asia.

Specimens examined : 2 males, 1 of paratype status, collected by S. K. Dasgupta from Baguihati (around Calcutta), West Bengal, at light trap during March 1958.

Comments : The vagueness of the limited pale spots in wings, male genitalia with a relatively stouter aedeagal body and spinosity of the caudal tips of parameres etc., distinguish the present species convincingly. Though it also seems to us to be a less common species of Culicoides, Dyce and Wirth (1983) finds it rather widely distributed in Southeast Asia.

Culicoides inexploratus Sen and Dasgupta

Culicoides inexploratus Sen and Dasgupta, 1959 : 628.

Female : unknown.

Male : scutum to postscutellum dark brown, without a pattern. Wing brownish with small pale spots at r-m, at distal half of second radial cell, at apical angle of wing in cell R_5 , two each

in cell M_1 and M_2 , and at cell M_4 ; macrotrichia restricted to stray few on radial vein and its branches. Haltere knob pale. Legs brown with narrow subapical and wide subbasal pale bands on all femora and first two tibiae, other tibiae totally pale; HTC of 4, second from spur longest. Genitalia - basic configuration Actoni Group type, with specialities as: apicolateral processes though feeble, rudimentary are visible each tipped by a small spine; aedeagal stem very short and bluntly rounded in its caudal tip.

Distribution : India (Dum Dum, around Calcutta, West Bengal).

Specimens examined : none.

Comments : Our inability to collect the samples of the present species from type locality or elsewhere, subsequent to its first collection, probably indicates its rarity in nature. It bears several such features as are rather uncommon for its group (Actoni Group); these are - somewhat well-formed apicolateral processes, no paleness apparent in basal and anal cell of wing etc.

C) ORIENTALIS GROUP OF SPECIES

Colicoides brevitarsis Kieffer

Colicoides brevitarsis Kieffer, 1917, 15 : 187.

Colicoides robertoi Lee and Reye, 1953, 77: 386.

Colicoides radicitus Delfinado, 1961: 657 (syn. of S. brevitarsis Kieffer, det. by Dyce and Wirth, 1983: 224).

Colicoides auriculatus Dasgupta, 1963f: 253 (syn. of S. brevitarsis Kieffer, det. by Dyce and Wirth, 1983 : 224).

Female : small, darkish ridge. Sencilla conicoconica on III, XI-XV, occasionally missing from XI. Wing blotched with large pale spots mostly interconnected; vein M_1 medially engulfed by a pale spot; shaded area before apical pale spot in cell R_5 columnar; macrotrichia scanty few in apex of cell R_5 . Haltere knob pale, whitish in fresh state. Legs banded, with subbasal pale spots on all femora and tibiae but subapical ones only on first four femora; BTC of 5, second from spur longest. Spermathecae two developed, grossly unequal, subspherical with short, sclerotized necks.

Male genitalia : sternum IX with concave caudal margin, tergum IX with the anal margin slightly conical, without any apicolateral processes; basistyle roots well developed, as two opposable thorny pieces, dististyle slender and gently curved; aedeagal body massive, twice as long as broad, its arms very short forming a low basal arch, stem also short, slender having finely rounded caudal tip and forming a peg-like structure at apex of aedeagus; parameres each with bent, thick base, its slender stem tapered to a pointed, simple apex.

Distribution : India (around Calcutta, West Bengal), Malaysia, Indonesia, Philippine, Japanese Archipelago, Fiji Is. to Northern and Eastern Australia and New Guinea.

Specimens examined : none.

Comments : The present species seems to enjoy rather a limited distribution in India though it is widespread in Far Eastern countries.

Dyce and Wirth (1983) examining 1 male paratype of C. ignerianus Dasgupta and 1 male paratype of C. turgidus Sen and Dasgupta opined that those belonged to C. brevitarsis Kieffer. Previously while assessing accuracy of records of C. orientalis Macfie from several countries by different workers, Dyce (1979) indicated that the male specimens collected from Dum Dum (near Calcutta) and described under this specific name by Sen and Dasgupta (1959) probably belonged to C. brevitarsis Kieffer. It is a very important Avaritia species of Australasia, as the most likely natural vector of blue tongue virus.

Culicoides certus Dasgupta

Culicoides certus Dasgupta, 1962 : 537.

Female : Scutum to postscutellum dark brown, with 3 scutellar bristles. Sensilla coeloconica on III, VII - IX, XI - XV. Third palponere slightly swollen at middle and with sensory area in the form of 5 shallow, irregular pits. Mandible with 10 slightly incurved teeth, apical few thicker. Wing brownish with about 12 pale spots - those at base, at apical angle in cell R_5 and in cell M_4 large; macrotrichia scattered over entire wing surface. Halteres

knob pale. Legs brownish with wide subbasal pale spots on all femora and tibiae and similar subapical spots on fore and mid femora and on mid and hind tibiae narrower; HIC of 4, first from spur longest. Spermathecae two developed, sclerotized and subequal, and oval to subglobular with short, narrow and sclerotized necks.

Male : unknown.

Distribution : India (inside Calcutta, West Bengal).

Specimens examined : types not available; 1 additional specimen, collected from Hastings in July 1961, by S. K. Dasgupta at sticky trap, in slide-mounted state checked now.

Comments : The present species seems to be another less common form of Culicoides in its place of occurrence. It is, however, distinct in its group (Orientalis Group) by a somewhat atypical wing maculation with macrotrichia scattered practically all over the wing surface.

Culicoides fulvus Sen and Dasgupta

Culicoides fulvus Sen and Dasgupta, 1959 : 628

Female : scutum to postscutellum dark brown, 3 scutellar bristles. Wing dirty brownish with 6 pale spots in distal half of wing, those in basal half being rather large, extensive; second radial cell pale only at extreme apex; macrotrichia stray few in cell R_5 and M_1 close to apical margin. Haltere knob pale, whitish in fresh state.

Legs dark brown; wide subapical and narrow subbasal pale bands on femora and tibiae; HTG of 5, first from spur longest. Spermathecae two developed, sclerotized, subequal and pyriform, with short, sclerotized necks.

Male genitalia : sternum IX with a shallow caudomedial depression; tergum IX with caudal margin bilobate but without any epicolateral processes; basistyle with just prominent internal roots, dististyle nearly straight though hook-tipped; sedae typical while parameres each owl-shaped and distinct in having 2-5 spines at filamentous tip.

Distribution : India (Dum Dum and Baguiati around Calcutta, West Bengal; Madras, Tamilnadu State).

Specimens examined : 1 female only, from Dum Dum around Calcutta, by S. K. Dasgupta at Sticky trap during March 1961.

Comments : The present species seems not very uncommon in its place of occurrence though it could not be collected by us in recent years. Types and paratypes of the species being not available now, we could not critically examine the male genitalia. Thus we could now neither confirm nor disagree with the contention of Dyce and Wirth (1933) that the small, ball-like preapical swelling at caudal end of paramere tip of C. fulvum was an observational error, the area in point apparently filamentous, as they could

infer on a scrutiny of a male cotype of G. fulvus. In our view, it is easily identified by the subtler characteristics of its wing maculation - second radial cell almost totally shaded and none of the branches of medial vein showing any paleness. Dyce and Wirth (1983) examining 1 male and 2 females slide-mounts of cotype status of G. turgidus Sen and Dasgupta, and the allotype male and another male slide-mount of G. pseudoturgidus Das Gupta opined that those belonged to G. fulvus Sen and Dasgupta.

Culicoides himalayae Kieffer

Culicoides himalayae Kieffer, 1911 : 326; 1911: 514.

Annandale, 1913: 246.- Mukerji, 1931: 1052 and 1056.

Medium sized blackish midge. Wing pale with 3 irregular, transverse smoky patches - one at front border extending to tip of vein M_{3+4} and sending branches along vein M_1 and M_2 , the other covering vein R_{4+5} while the remaining one restricted to apical margin. Haltere white. Spermathecae two, unequal and subspherical.

Distribution : India (Kurseong and Calcutta, West Bengal; Kalimpong in the Nepal-Sikkim Frontier at 9000 ft.).

Specimens examined : none.

Comments : Described in both sexes by Kieffer (1911) from Kurseong, the present is still very incompletely known. Subsequent records do not clarify its nature profitably and the damaged female preserved as its sample in the B.S.I., Calcutta, is unfit for a further study.

Culicoides imicola Kieffer

Culicoides imicola Kieffer, 1913 :

Culicoides pallidipennis Carter, Ingram and Macfie, 1920: 265.

Culicoides minutus Sen and Dasgupta, 1959: 622

(syn. of C. imicola Kieffer, det. by Dyce and Wirth, 1983: 221).

Culicoides pseudoturricus Dasgupta, 1962:538;1962:

(syn. of C. imicola Kieffer, det. by Dyce and Wirth, 1983: 223).

Female : Eyes contiguous for 2 facet-length, bare. Sensilla coeloconica on antennomeres III, XI - XV. Third palpus shorter than second, slightly swollen medially and with a shallow sensory pit preapically. Mesonotum simple brown, unmarked. Wing brownish with large, interconnected pale spots, the one halfway between second radial cell and apex of cell R_5 hourglass-shaped; vein M_1 engulfed by a medial pale spot, vein M_2 totally dark; spermathecae two developed, sclerotized, subequal and subspherical, with short, narrow, sclerotized necks.

Male genitalia : sternum IX in its caudal margin concave or depressed, ventral membrane from it apiculate; tergum IX also concave in its caudal margin or with a shallow medial cleft and appearing bilobate but never with apicolateral processes; basityllic roots thorn-like, prominent; aedeagus conical with very short arms but long, slender stem finely rounded at caudal end; parameres each somewhat awl-shaped, its caudal end filamentous, simple.

Distribution : Angola, Ghana, Kenya, Nigeria, Uganda and a few other adjoining African countries; India (Dum Dum, around Calcutta, West Bengal).

Specimens examined : Holotype female from Dum Dum, by S. K. Dasgupta at light trap in July 1960.

Comments : The present species is mainly an Ethiopian species, and its occurrence in India is contended by Dyce and Wirth (1983) who examining the types of the closely related species C. minutus Sen and Dasgupta and C. pseudoturgidus Sen and Dasgupta, collected from Dum Dum around Calcutta, opined that all these were conspecific. They also find a female of C. turgidus Sen and Dasgupta, also collected from Dum Dum, as same as C. jivicola Kieffer which apparently a less common form in India is quite well-known in Africa as freely attacking cattle and sheep, and acting as a natural vector of blue tongue virus.

Gulicoides molestus Kieffer

Gulicoides molestus Kieffer, 1910: 192.- Annandale, 1913: 246.- Sen and Dasgupta, 1953f: 163; 1959b : 620; 1959d: 65 (as, G. insignis nom. nov.)

Gulicoides molestus Kieffer, 1911c: 514 (nom. nov. for G. molestus Kieff., nec Ceratopogon molestus Skuse, since transferred to Gulicoides, by Macfie, 1959a: 556).

Small sized, blackish midge with dull brown thorax. Wing with extensive, interconnected pale areas and smoky dark spots as, at tip of cell R_5 and vein M_1 , at middle of radial vein, at second radial cell, at fork of medial vein, in cell R_2 and cell M_4 ; macrotrichia sparse, in distal half of wing surface. Halteres brownish white.

Distribution : India (Calcutta and Kurrcong, West Bengal).

Specimens examined : none; dry-mounted female specimens in the U.S.I., Calcutta, not available now.

Comments : In his check-list of Oriental Ceratopogonidae, Wirth (1973) treats the present species as an unplaceable one within Gulicoides apparently for its incomplete description though it was described in both sexes. The available description, however, indicates its wing nature being of Avaritia type since pale areas

are large and interconnected, and macrotrichia in wing surface are sparse.

Culicoides odiosus Kieffer

Culicoides odiosus Kieffer, 1910: 192; 1911c: 515;
1913: 193.

Brown ridge of moderate length. Wing smoky with ill-defined extensive pale areas - at base, 2 each in cell R_5 and anal cell, and all pale spots interconnected; radial cells vague.

Distribution : India (Calcutta and Kurseong, West Bengal).

Specimens examined : none.

Comments : described in female only, it is like C. polioctus Kieffer is also very imperfectly known. The two species, however, appear comparable and related.

Culicoides neralini Dasgupta

Culicoides neralini Dasgupta, 1962c: 533.

Female : Mesonotus light brown, unmarked with 7 scutellar bristles and postscutellum darkening somewhat intensely caudad. Wing with some 8 brownish spots - at middle of radial vein, at intersection of two radial cells, halfway between second radial cell and apex in cell R_5 and this being narrowly columnar, at middle of medio-cubital vein with others in anal cell and on veins M_2 and M_{3+4} ; the pale areas are very extensively interconnected; macro-

trichia sparse few in wing surface along wing margin from cell R_5 to anal cell. Haltere pale. Legs brown with subbasal pale spots on all femora and tibiae, subsapical pale spots on hind tibiae; HTC of ♀, first from spur longest. Spermathecae two developed, sclerotized and unequal, pyriform with short and narrow sclerotized necks.

Male : unknown.

Distribution : India (Dum Dum, Belgharia and Mathpukur around Calcutta, West Bengal).

Specimens examined : 2 females collected from Mathpukur (near Calcutta) in January 1961 by S. K. Dasgupta at sticky trap (partly damaged).

Comments : The present species is the palest of all Avaritia species, known from West Bengal; its wings are with very large, interconnected pale areas recalling C. liui Wirth and Hubert from Taiwan and Thailand from which it differs in some subtle respects including tibial comb with the first spine from spur end longest and very narrow sclerotized operathecocal necks. It also seems to be a less common form of Culicoides as subsequent efforts did not enable us to collect more of its samples from its place of occurrence.

Culicoides fuscidus Sen and Dasgupta

Culicoides fuscidus Sen and Dasgupta, 1959b: 626.-

Dasgupta, 1961: 193 (records, bionomics); 1964:149.-

Byce and Wirth, 1983: 222 (notes).

Female : scutum pale yellow with brown vittae and two very well formed spots at middle, scutellum and postscutellum brown with 4 scutellar bristles. Eyes and antennal features typical of the Orientalis Group. Wing light brown with well formed pale spots at base, at r-m, at apical third of second radial cell, at apex in cell R₅, on distal third of vein M₁, two each in cell M₁ and anal cell and touching margin at each of cell M₂ and M₄; a pale streak extends from wing base to distal third of cell M₂; macrotrichia scanty few in radial vein and marginally in cell R₅ and M₁. Legs brown with subapical and subbasal pale bands on all femora and last two tibiae but with subapical pale band on fore tibiae only; hind tibial comb of 5 spines, the first from spur longest. Spermathecae two developed, sclerotized, pyriform and subequal with prominent sclerotized necks.

Male genitalia : patterned after fulvus specialities being - dististyle relatively shorter compared to basistyle whose two internal roots are both acuminate, thorn-like; aedeagal arch very low, arms almost straightaway directed outward and caudal stem of aedeagus narrowly linear while caudal tip of each paramere with more spines i.e., densely spinose.

Distribution : India (in and around Calcutta and remote suburbs like Uttarpara and Kennagar, Jhargram - West Bengal).

Specimens examined : 10 females and 4 males, collected from suburbs of Calcutta, West Bengal, by S. K. Dasgupta at light and Sticky trap during January 1957 to March 1958.

Comments : The present species is a common form of Culiseta in and around Calcutta. It closely resembles several Avosittia species of the Orientalis Group. A scutal pattern consisting of a pair of brown spots and 3 longitudinal, linear vittae is distinctive (Dasgupta, 1964). Also distinctive are: apical third of lumen of second radial cell, the straight column-like dark spot halfway between second radial cell and apex in cell R_{5+6} , pale spot in distal third of vein M_1 , and paleness in anal cell as two separate spots. The specialities in male genitalia stated before also help in its distinction. Byce and Wirth (1963) examining some type specimens of the present species find that except the holotype female which it was damaged the others could be relegated to the closely resembling species, C. brevitarsis Kieffer, C. fulvus Sen and Dasgupta and C. imicola Kieffer. They, therefore, preferred to treat C. turgidus Sen and Dasgupta as a nomen dubium which in our experience does not probably reflect the correct situation since we can distinguish the species concerned with additional material we have in hand easily.

KEY TO WEST BENGAL SPECIES OF SUBGENUS AVANTIA

1. Wing surface showing not more than 3 shaded patches C. himalayae
- Wing surface showing more than 3 shaded patches 2
2. Wing with vein M_1 engulfed medially by a pale spot or a pale streak extends along most of the vein 3
- Wing with vein M_1 totally shaded 3
3. Pale areas in wing surface not interconnected mostly, as separate pale spots of variable size 4
- Pale areas in wing surface mostly interconnected 6
4. Vein M_1 in wing with a mere pale streak along its course C. astoni
- Vein M_1 in wing engulfed clearly at middle by a pale area 5

- 5. Pale spot at r-m cross vein in wing
confluent with the pale area below the
medial vein; spermathecae grossly
unequal G. imicola
- Pale spot at r-m cross vein in wing
separated from the pale area below
medial vein by a shaded streak in
between; pale area in cell M₄ very
large and spermathecae grossly
unequal G. brevitarvis
- Pale spot at r-m cross vein in wing
separated from pale area below
medial vein by a shaded streak in
between; pale area in cell M₄ rather
small and spermathecae subequal ... G. turgidus
- 6. Wing cell M₁ and M₂ totally pale,
paleness in M₂ continued to wing
base uninterrupted G. parvulus
- Wing cell M₁ and M₂ not totally
pale

7. Wing cell R_3 with only 2 pale spots touching wing margin C. holosericea
- Wing cell R_3 with 3 pale spots touching wing margin C. odiosa
8. Distal-most pale spot in wing cell R_3 small and not touching wing margin C. dumulata
- Distal-most pale spot in wing cell R_3 small or large but always touching wing margin 9
9. Distal-most pale spot in cell R_3 small, the dark area between it and the post-stigmatic pale spot very large C. inaequalis
- Distal-most pale spot in cell R_3 small; large, the dark area between it and the post-stigmatic pale spot small.. 10
10. Wing cell R_2 with one large, elongated pale area occupying most of the cell surface C. autumnalis
- Wing cell R_2 with two pale spots ... 11

11. Surface macrotrichia in wing abundant; lumen of second radial cell invaded by post-stigmatic pale spot G. gertun
- Surface macrotrichia in wing sparse though available in cell R_5 to anal cell; post-stigmatic pale spot clearly beyond second radial cell and that at r-m confluent with the pale area underlying medial vein G. definitus
- Surface macrotrichia in wing scarce, marginal few in cell R_5 and M_1 ; post-stigmatic pale spot invades tip of vein R_{4+5} and that at r-m separated from the pale area underlying medial vein by a broadly shaded area G. definitus

Subgenus Beltranyia Vargas, 1953:54

(Type of the subgenus : Culicoides crenularia Malloch, by original designation).

General characters : Wings with pale spots, faintly or well marked; macrotrichia rather coarse and copious in their surfaces, even in basal cell; second radial cell dark, veins M_1 and M_2 never straddled by pale spots. Eyes separated, bare. Sensilla coeloconica variably on III - XV. Third palpomere swollen medially with a shallow,

wide sensory pit. Spermathecae apparatus of only one developed spermatheca, sclerotized with very short such a neck, rudimentary one or a ring not visible. Male genitalia with well developed apicolateral processes, ventral membrane usually apiculate, basistylic dorsal root prominent, ventral root none or very short and dististyle showingly swollen at base; aedeagus usually with short, bluntly rounded caudal tip and paramere each with its basal knob thick and produced caudad to a simple, filamentous tip bent laterad while its pre-basal knob part flexed twice and expended at second flexure.

The Beltranmya subgenus is a small one though its representatives prevail in different geographical regions. Most of the European species are placed in the Salinarius Group by Campbell and Pelham-Clinton (1960) while Boorman and Dipeolu (1979) places the single Nigerian species of this subgenus in the Noviosus Group. The single Indian species deal now was placed in the Circumscriptus Group of the subgenus by Majumdar and Dasgupta (1972) and we retain it since this group name is quite old and covers the species concerned most cogently.

Circumscriptus Group : Wing with many pale spots, two each in cell R_5 to M_1 ; scutum usually with dark spots at hair bases; sensilla coeloconica on antennomeres III - XIV, none on XV. Third palpomere highly swollen at distal third, then tapers concially; aedeagal arch high, more than half of aedeagal length, its arms long, rod-like and slightly divergent though well sclerotized for most part.

A) CIRCUMSCRIPTUS GROUP OF SPECIES

Calicoidea circumscriptus Kieffer, 1918, 16:49.

Calicoidea magnificus Sen and Dasgupta, 1959b, 52 : 622

(syn. of C. circumscriptus Kieffer, det. by Majumdar and Dasgupta, 1972: 106).

Female : sensilla coeloconica on III - XIV. Third palpomere swollen past middle, its apex conically tapered and a large sensory pit past middle. Mandible with 16 slightly incurved, unequal though small teeth. Scutum dark brown with copious dark marks blending into grey middorsal vittae and lateral darkish patches; scutellum with 4 large and 12 small bristles. Legs brown with basal pale spots on all femora, subapical pale spots on first four femora while tibiae are only with subbasal pale spots; HPC of 4, first from spur longest. Wing grayish brown with enough pale spots and macrotrichia, typical of the Circumscriptus Group; second radial cell totally shaded, larger than first. Haltere yellowish white. Spermatheca only one, developed and intensely sclerotized, elongate oval with very narrow, short neck.

Male genitalia : typical of the Circumscriptus Group. Bacistyle broad, usually with a longitudinally set sclerotisation line-work; aedeagus with blunt caudal tip occasionally bearing a pair of sclerotized bar-like pieces.

Distribution : North Africa, Eurasia, China, India, Japan and Thailand (Tokunaga, 1937; Edwards et al. 1939; Arnaud, 1956; Clastrier, 1957; Campbell and Pelham-Clinton, 1960; Gutsevich, 1973).

Specimens examined : 19 females, 10 males in slide-mounts, all collected by S. K. Dasgupta during 1966-1968 from several parts of West Bengal (Burdwan, Chinsura, Habra, Gobardanga and Itachuna); also examined 2 females, 1 male given to us by Dr. Gutsevich from his Soviet Middle Asia collection; and types of G. magnificus Sen and Dasgupta, collected from Calcutta at light trap during November 1956. Some 15 females, 6 males collected by P. P. Choudhuri at light trap during 1977-1979 from such parts of West Bengal as Raniganj, Serampore and Bolpur were also examined.

Comments : The present species seems to be a very common form of Gulicoidea of the plains of West Bengal. From its distribution range as we know, it is most likely that further search will show its occurrence in other parts of India as well. It is an well-adorned, conspicuous species with enough variability in its features. The synonymisation of G. magnificus with it by Majumdar and Dasgupta (1972) bears this out and its close resemblance with the Nigerian species G. nivogus De Meillon is noteworthy.

Subgenus Culicoides Latreille, 1809, 4:251

(Type of the subgenus : Culex culicaris Linn., as
Coratopogon punctatus Meigen, monobasic)

General characters : large sized, dark. Wing usually with prominent pale spots which cover r-m and second radial cell substantially; base of cell M_4 dark. Third palpal segment tapered distal to the sensory pit or the sensory hair bearing area (when pit not formed). Distal sensilla ecloconica confined to III, XI - XV, HFC of 5-6, second usually the longest. Spermathecae two well developed with one rudimentary, the developed two subequal to unequal, mostly pyriform. In male genitalia, apicolateral processes either absent or poorly developed; basistyle with ventral roots undeveloped; aedeagus usually with a sclerotized anterior band near base of arch, distal peg in it absent but a thinly sclerotized membrane often forms a small distal arch and its stem long, slender ending in a finely rounded spherical (ball-like) tip; parameres abruptly bent at base, each tapering to curved, pointed, hairy or bare tip.

The 9 species of Culicoides belonging to subgenus Culicoides are found to occur in the State of West Bengal and these may be placed under 2 known groups of species within the subgenus. The important characters of these 2 groups are as follows :

Aterinervis Group : eyes broadly contiguous, bare; third palpal segment without any definite sensory pit, sensory hairs variously scattered in segment III, occasionally in segments II and IV also; wings of brown to brownish shade with isolated/interconnected pale spots; second radial cell quite spacious; macrotrichia scanty; HTC of 6, second from spur longest; spermathecae well sclerotized, their necks not broad but sclerotized for a short distance from beginning; in male genitalia, tergum IX subconical to rectangular with a caudo-medial cleft but mostly without any apicolateral processes; basistyle with coarse mesal spines; aedeagus with short, outcurved basal arms, its basal arch shallow and its narrow, linear stem ending in a ball-like tip.

The Aterinervis Groups under subgenus Culicoides was first proposed by Majumdar and Dasgupta (1972) to include all 7 species which they described as new from Darjeeling; the same species are being reviewed here after these were restudied now on basis of their material and further collection to the date.

Innoxius Group : eyes narrowly contiguous, bare; third palpal segment with a definite though shallow sensory pit; wings blackish brown with isolated pale spots, second radial cell not unusually large and macrotrichia scanty; spermathecae well sclerotized, pyriform with their necks neither broad nor sclerotized at beginning; in male genitalia, tergum IX subconical or broadly oval without any apicolateral processes; aedeagus with short, slender outcurved arms its basal arch shallow and stem linear and finely rounded.

The *Innoxius* Group under subgenus Culicoides was first proposed by Majumdar and Dasgupta (1972) to include some 3 species of which one, C. subinnoxius, was described by them as new to science. This and another known species were found as existing in West Bengal and the same were reviewed here after a study of all available material.

A) *ATERINERVIS* GROUP OF SPECIES

Culicoides innoxialis Majumdar and Dasgupta, n. sp.
1972 :143

(Figs. 8a-c)

Pozale : intensely dark brown frontovertex with 20 setae. Third palponere swollen at middle, then tapering and with about 10 sensory hairs arising from respective alveolus which do not coalesce to form any sensory pit though adjacent 1, 2 or few may overlap. Scutum brown to brownish with darker streaks/splash in the form of lateral vittae and terminal patches. Legs light brown with pale spots at two ends. Wings brown to brownish with 9 well defined pale spots, that at base extensive invading anal cell whose distalmost pale spot elongate, conical; macrotrichia stray few in distal part of cell R_5 to cell M_4 . Spermathecae two developed and subequal, well sclerotized and pyriform with very short sclerotized necks.

Male genitalia : tergum IX almost semicircular with a caudo-medial cleft but no apicolateral processes; incurved, slender dististyle with hooked tip; aedeagus massive, conical with very short arms, its stem as a slender rod thickened to a ball-like tip; parameres each with double flexure cephalad, its straight part slimming caudad to a pointed tip bearing 4-5 small spines.

Distribution : India (Darjeeling town, west Bengal).

Specimens examined : 30 females, 8 males including types, all collected from Govt. College Campus, Darjeeling, by S. K. Dasgupta at light trap during March - September 1968 and during May-August 1978 by P. P. Choudhuri.

Comments : It is one of 6 species of Aterinervia Group described from Darjeeling which turn up in light trap collection in fairly good number. Its distinctive are colour pattern of scutum consisting of a pair of dark vittae laterad, one each through middle though it is snapped centrally and a dark patch at anterior and posterior end while in wing surface the basal pale spot is very extensive covering basal half of anal cell and the other pale spot in anal cell is elongate conical, never bilobed.

Calicoidea psorexalis Majumdar and Dasgupta, n. sp.

1972 : 161

(Figs. 8d-f)

Female : intensely dark brown frontovertex with 12 setae. Third palponera swollen at middle, then tapering and with about 9 sensory

Hairs arising from respective alveolus which mostly do not coalesce as a pit. Scutum brown to brownish with darkish mark/vittae as, one pair patch closely set to each other just before middle and one L-shaped streak laterad in anterior half. Legs brown to brownish with pale spot either at base or at apex or at both ends in femora and tibiae, the basal one at mid and hind tibia quite extended covering basal third. Wings brownish with extensive, interconnected pale areas, the darkish shade in fact reduced to several darkish spots in wing surface with one before r-m, one at junction of two radial cells, one at base of vein M_2 , one extending as a narrow streak from cell M_2 distally to the tip of vein M_{3+4} , one covering cubital vein and one at middle of anal cell; macrotrichia stray few in distal third of cell R_5 to cell M_4 . Spermathecae two developed, subequal to unequal, well sclerotized and pyriform with short, sclerotized necks.

Male genitalia : basic design as in f. isoregalis with specialities - dististyle very strongly incurved at middle, aedeagal stem sharply marked off from main aedeagal body, rudimentary epicolateral processes in tergum IX and paramere knob rather thick and awl-shaped.

Distribution : India (Darjeeling town, West Bengal).

Specimens examined : 21 females, 13 males including types, all collected from Govt. College Campus, Darjeeling, by S. K. Dasgupta at light trap during March - September 1968 and during October 1978 by P. P. Choudhuri.

Comments : C. neoregalis is quite distinct in having very extensive pale spots in wings in the form of 4 costal to anal-margin bands, scutal pattern of 2 medial darkish spots flanked by lateral vittae and awl-shaped parameres in male genitalia. It recalls C. dubius Arnaud which, however, differs in having more abundant wing macrotrichia and broader paramere tip and aedeagal stem. The Philippine species C. unicus Delfinado, collected from Mt. McKinley at 3300' has a close resemblance with it in wing colouration.

Culicoides neoregalis Majumdar and Dasgupta, n.sp.

1972 : 161

(Fig. 8g)

Female : intensely dark brown frontovertex with 16 setae. Third palpomere just swollen at middle, then tapering and with about 7 sensory hairs arising from respective alveolus. Scutum light brown with stray dark brown marks at its two ends. Legs brown to brownish with pale spots at both ends of first four femora and hind tibia but only at base in case of hind femora and first four tibiae, the paleness at base of hind tibia is very extensive covering nearly basal half. Wings light brown with 9-10 clearly marked pale spots, that at base extensive invading also the basal half of anal cell while the other pale spot in anal cell is bilobed and in fact as two separated, small spots; macrotrichia scanty, restricted in distal part of cell R_5 to cell M_2 . Sporne-

thecae two developed, slightly unequal, well sclerotized and pyriform with short, sclerotized necks.

Male : unknown.

Distribution : India (Darjeeling town, West Bengal).

Specimens examined : 3 females only including type collected from Govt. College Campus, Darjeeling, by S. K. Dasgupta at light trap during July 1968 and July 1978 by P. P. Choudhuri.

Comments : C. narayegalis seems to be rather the scarcer element of the Aterinervis Group at Darjeeling. It is distinguished by the third palpal segment rather slim, characteristic leg colouration with almost the basal half of hind tibia pale and the basal pale spot in anal cell extending to wing margin while the other pale spot in the cell bilobed almost as two pale spots touching each other. It recalls the Philippine species C. recurvus Delphinado especially in very similar wing colouration.

Culicoides pseudoregalis Majumdar and Dasgupta, n. sp.

1972 : 176.

(Fig. 8h)

Female : intensely dark brown frontovertex with 17 setae. Third palpomere elongate, biconcave due to medial swelling, without any sensory pit and about 16 sensory hairs scattered over its distal two-third; also 3-4 such hairs apical of palpomeres II and IV.

Scutum grayish brown with a pair of dark brown oval spots sub-medially, its both ends also dark brown and a thick dark brown vitta extends almost from end to end sublaterally with transverse streaks from each vitta to extreme margin at humeral pit level and at mid level of scutum. Legs brown to brownish with apical pale spots in first two femora and hind tibia but basal pale spot in all tibiae. Wings grayish brown with 9-11 clearly marked, smaller pale spots not in wing surface as noted for isoregalia, both pale spots in anal cell bilobed, macrotrichia not too scanty rather abundant in the distal half of cell R_5 . Spermathecae two developed, grossly unequal, well sclerotized and pyriform with short, sclerotized necks.

Male : unknown.

Distribution : India (Darjeeling town, West Bengal).

Specimens examined : 8 females including types, collected from Govt. College Campus, Darjeeling, by S. K. Dasgupta at light trap during August 1968 and during August 1979 by P.P. Choudhuri.

Comments : The colour pattern of scutum of the present species resembles that of C. neoregalia from which, however, it differs in respect of wing colouration and leg banding. It also appears to be a scarcer element of the Aterinervis Group at Darjeeling.

Gulicoides quasiregalis Majumdar and Dasgupta, n. sp.

1972 : 180

(Fig. 81)

Female : intensely dark brown frontovertex with 16 setae. Third palpomere elongate, slightly inflating at middle and without any sensory pit, some 11 sensory hairs scattered all over the segment while 1-3 such hairs also occur apical of palpomeres II and IV. Scutum grayish brown with two linear sublateral darkish vittae and transverse darkish streaks at humeral pit level and at mid level on two sides of scutum. Legs brown to brownish with pale spots in femora and tibiae as in case of pseudoregalis. Wings grayish brown with pale spots set as in case of pseudoregalis though larger comparatively and macrotrichia distribution in the two also almost similar. Spermathecae two developed, subequal, well sclerotized and pyriform with short, sclerotized necks.

Male : unknown.

Distribution : India (Darjeeling town, West Bengal).

Specimens examined : 4 females including types, collected from Govt. College Campus, Darjeeling, by S. K. Dasgupta at light trap in August 1968.

Comments : The present species resembles G. pseudoregalis very closely. But the scutal colouration in the two are characteristically and consistently being different, pseudoregalis having

Fig. 8. Culicoides isoresalis Majumdar and Dasgupta, n.sp.; a-c:
a, female wing; b, male aedeagus; c, male paramere.

Culicoides neoresalis Majumdar and Dasgupta, n.sp.; d-f:
d, female wing; e, male aedeagus; f, male paramere.

Culicoides pararesalis Majumdar and Dasgupta, n.sp. :
g, female wing.

Culicoides pseudoresalis Majumdar and Dasgupta, n.sp. :
h, female wing.

Culicoides quaeiresalis Majumdar and Dasgupta, n.sp. :
i, female wing.

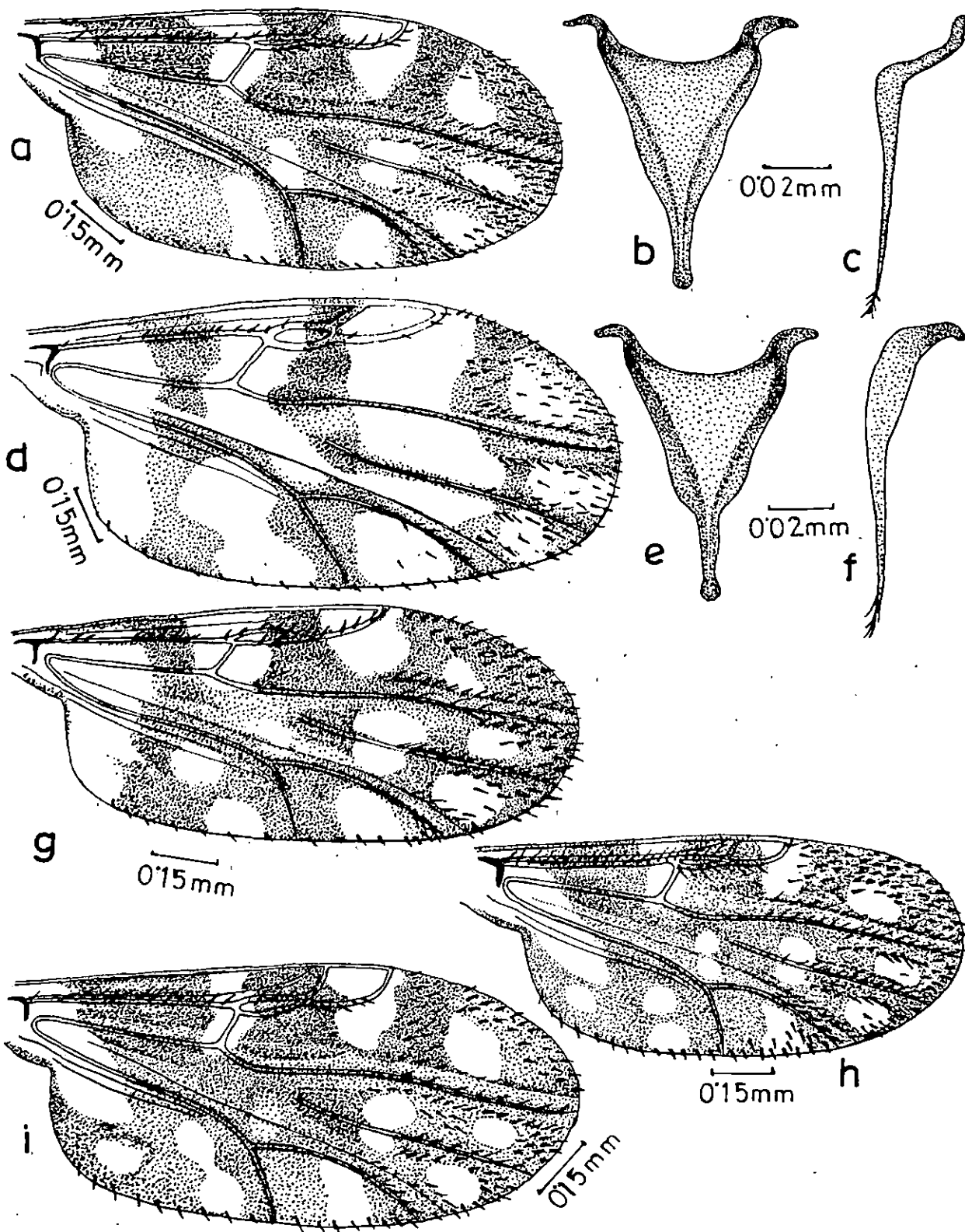


FIG-8

richly darkish anterior and posterior ends, subglobular darkish spots near middle and 3 longitudinally set vittae, it seems justified to declare the specimens of the present species as belonging to a different species. It recalls the wing colouration of the Philippine species C. hirtipennis Delfinado collected at 1500' altitude.

Colicoidea rosalia Majumdar and Dasgupta, n. sp.

1972: 188.

(Figs. 9a-c)

Female : intensely dark brown frontovertex with 14 setae. Third palpomere very long, imperceptibly swelling till distal fourth and then attenuated, without any sensory pit and with about 12 sensory hairs scattered apicad. Scutum brown to brownish with anterior and posterior ends bleached with darkish patch, there being 3 linear very narrow longitudinal vittae one medial and the others sublateral. Legs brown to brownish with pale spots in femora and tibiae as in case of isoregalis. Wings brown to brownish with pattern of pale spots basically same as in isoregalis but those spots are larger, specially noteworthy being the spot at wing base which broadly invades anal cell almost down to anal margin; macrotrichia rather scanty though seen down to cell M_2 . Spermathecae two developed, subequal, well sclerotized and pyriform with short, sclerotized necks.

Male genitalia : sternum IX with shallow caudomedial excavation; tergum IX subrectangular with a median cleft but no apico-lateral processes; aedeagal stem short and prominent as two arms; parameres with part cephalad of flexure is rather long and not awl-shaped.

Distribution : India (Darjeeling town, West Bengal).

Specimens examined : 28 females, 24 males including types, all collected from Govt. College Campus, Darjeeling, by S. K. Dasgupta at light trap during March - September 1968 and during May-July 1978 by P. P. Choudhuri.

Comments : The present species is the most abundant element of the *Atoxinervis* Group of *Culicoides* at Darjeeling. Its closest ally is *C. isoregalis*, also described from Darjeeling, but its characteristic scutal pattern and larger pale spots in wing surface are highly distinctive.

Culicoides subregalis Majumdar and Dasgupta, n.sp.

1972 : 228

(Figs. 9 d-f)

Female : Intensely dark brown frontovertex with 13 setae. Third palpomere slightly attenuated in distal fourth through progressively swollen from base towards middle, without any sensory pit and with about 9 sensory hairs scattered subapical.

Scutum brown to brownish with darkish shade at two ends plus two sublateral narrow, linear vittae and a similar lateral vitta extending from humeral pit level to mid level. Legs light brown with pale spots in femora and tibiae as in isoregalis (basal spot in tibiae in the present species more extended). Wings brown to brownish with about 10 well defined, large pale spots as in isoregalis; macrotrichia in distal part of cell R_5 to cell M_2 in good number. Spermathecae two developed, unequal and prominently pyriform with short, sclerotized necks.

Male genitalia : sternum IX slightly depressed caudomedially; tergum IX subrectangular with a prominent caudomedial cleft but no apicolateral processes; slightly incurved dististyle with a hooked tip, aedeagus massive with arms quite reduced, as were slender pointed projections, and stem comparatively more prominent; parameres awl-shaped, its straight part blimping caudad to a pointed tip, bearing 2-3 small spines.

Distribution : India (Darjeeling town, West Bengal).

Specimens examined : 33 females, 15 males including types, all collected from Govt. College Campus, Darjeeling, by S.K. Dasgupta at light trap during June-September and during July 1979 by P.P. Choudhuri.

Comments/: The present species closely resembles C. isorogalis. However, its distinctive features are - a limited number of setae in frontovertex, scutal pattern composed mainly of two darkish linear vittae stretching sublaterally from end to end, relatively large-sized pale spots in wings, strongly pyriform functional spermathecae and awl-shaped parameres each having just 2-3 spines at caudal end. It appears that the species is a common form of Culicoides at Darjeeling area.

B) INNOKIUS GROUP OF SPECIES

Culicoides innoxius Sen and Dasgupta, 1959:626.

Female/: brown frontovertex with 20 setae. Third palpomere about 2 x length of II, swollen at middle and then tapering with a postmedial shallow sensory pit. Scutellum yellowish brown with stray darkish spots. Legs dark brown, all femora and tibiae with pale spots at base and while fore tibia pale at both ends the last four tibiae pale at base only. Wings lightly smoky with paleness at basal one fourth and about 11 pale spots in rest of their surfaces as : at r-m extending in costa and covering most of first radial cell, at distal half of second radial cell, distally in cell R_5 in the form of a roundish spot not touching wing margin, two each in cell M_1 , M_2 and anal cell while cell M_4 bears 1 small pale spot touching margin; macrotrichia scanty, with stray few in distal part of cell R_5 and M_1 . Spermathecae two developed though unequal,

sclerotized and oval to pyriform with necks narrow and unsclerotized almost from beginning.

Male genitalia : sternum IX with a shallow caudomedial depression, tergum IX almost conical without a cleft (found in some specimens) and a pair of AP-Basistyle with a prominent, rod-like dorsal root, ventral root not perceptible; aedeagus with rod-like outcurved arms, its stem also rod-like but slightly swollen for most part and abruptly slimming caudad to a finely rounded tip; parameres each somewhat awl-shaped with a thread-like caudal part having 6-7 spines.

Distribution : India (several places in West Bengal); Borneo, Cambodia, Sri Lanka, Malaya and Thailand (Wirth, 1973).

Specimens examined : Over 200 specimens of both sexes (including Paratypes, 4 females and 3 males), collected from various locations in West Bengal State: in and around Calcutta, Burdwan, Coochbehar, Gobardanga, Habra, Raniganj and Siliguri, by S. K. Dasgupta, and B. C. Majumdar during different seasons of 1955 - 1965 by light/sticky trap as well as by rearing from rotting banana vegetation; also collected 5 females, 3 males by P. P. Choudhuri from Serampore during March - April 1981 at light trap.

Comments : The present species resembles C. indianus Macfie described from Dharwar (near Bombay) and many Southeast Asian countries. It is, however, distinct in its scutum having a colour

Fig. 9. Culicoides resalis Majumdar and Dasgupta, n.sp.; a-c:
a, female wing; b, male aedeagus; c, male paramere.

Culicoides subresalis Majumdar and Dasgupta, n.sp.; d-f:
d, female wing; e, male aedeagus; f, male paramere.

Culicoides subinnocens Majumdar and Dasgupta, n.sp.; g-i:
g, male wing; h, male aedeagus; i, male paramere.

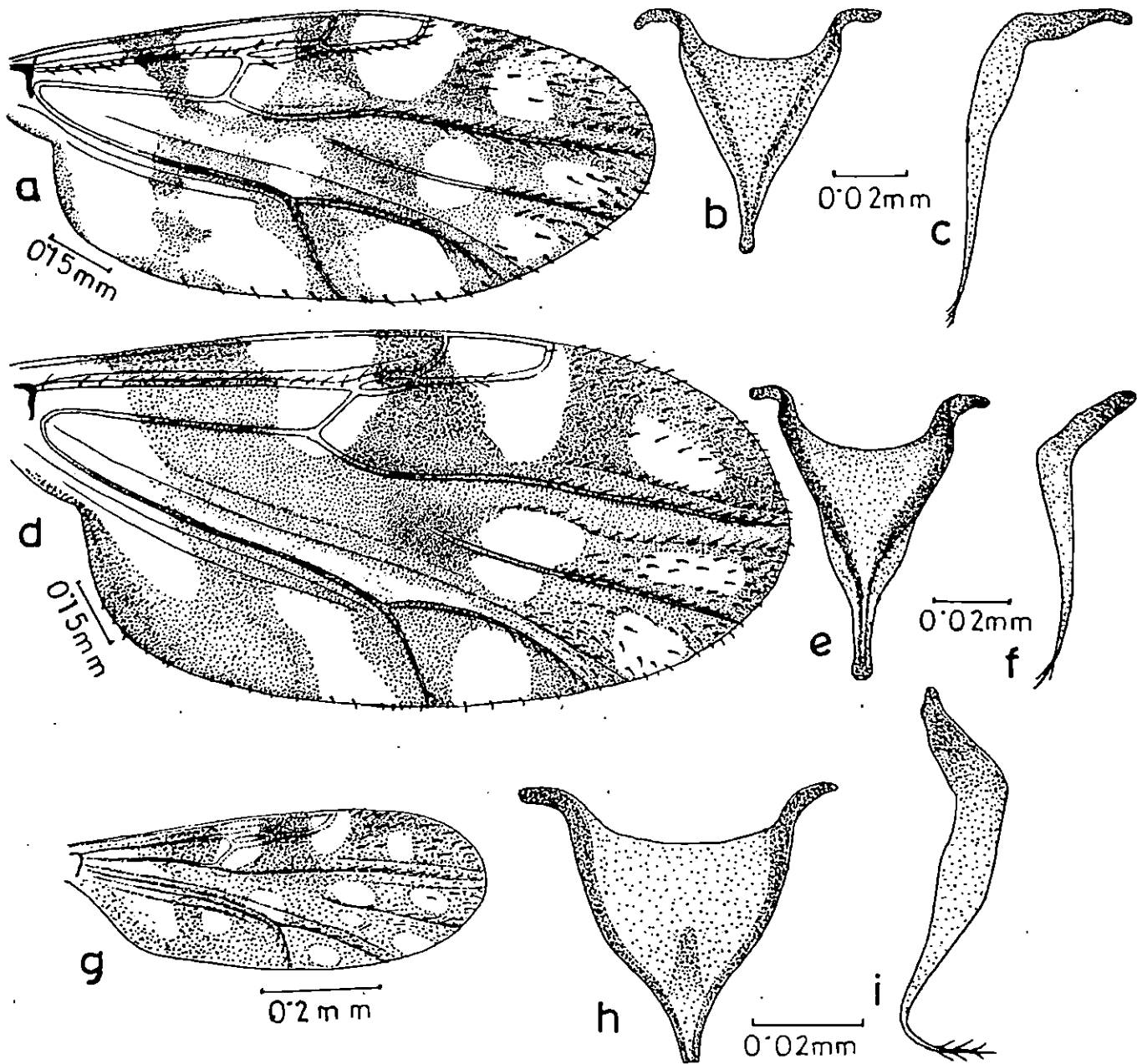


FIG.-9

pattern, cell M_1 and M_2 in wings each having 2 pale spots and not 1 and the totally pale haltere. In its place of occurrence, in India, it is found to prevail abundantly and it shows some variations of characters.

Culicoides subinnoxius Majumdar and Dasgupta, n. sp.,

1972 : 220.

(Figs. 9 g-1)

Female : unknown.

Male : Wings closely resembles those of innoxius, light smoky wings with about 11 small pale spots and a broad pale area at base, the spot at r-m characteristically angular and meeting costa broadly. Leg colouration not palpably different from the same in innoxius. Genitalia - basic configuration as in innoxius but the aedeagal stem is very characteristically different - it is shorter than aedeagal arms, rod-like, slender and with a flat caudal tip; aedeagal arch relatively wider though lower.

Distribution : India (West Bengal).

Specimens examined : 6 males including types, all collected from College Campus, Habra, or Gobardanga by B. C. Majumdar on July 1966, at light trap or by rearing from rotting banana stumps.

Comments : The present species though based on a few males is remarkable in having aedeagal stem of genitalia shorter than aedeagal arms and ending in a flat, blunt caudal tip. In general body and wing colouration it resembles C. innoxius very closely with which it seems to be forming a sibling complex and recognition of its females will be possible only after a thorough biometric analysis of the complex is made.

KEY TO WEST BENGAL SPECIES OF SUBGENUS CULICOIDES

1. No sensory pit in third palpomere, sensory hairs scattered in the segment and occasionally also on second and even fourth palpomeres. Second radial cell in wing very broad and mostly pale, wing base also very extensively pale. Halteres infuscated except for knob-apex 2
2. Sensory hairs of maxillary palp located in a definitive sensory pit in third palpomere. Second radial cell in wing rather small, mostly shaded and paleness at wing base either very extensive or small, vague. Halteres totally pale.... 8
2. Wing with distalmost pale spot in cell R_5 broad and so extended to wing margin very clearly; other pale spots in wing also extensive, interconnected and forming apparently 4 pale bands stretched from costa to anal margin C. neoresalis

2. Wing with distalmost pale spot in cell R_5 rather small and separated from wing margin by a clouded streak; other pale spots in wing small, isolated 3
3. Sensory hairs scattered in third palponere only 4
4. Sensory hairs scattered in second to fourth palponeres 7
4. Paleness at wing base invades only the upper aspect of anal cell in wing 5
5. Paleness at wing base deeply invades the anal cell, even down to anal margin 6
5. Pale spot in anal cell close to vein Cu_1 , in wing, broad throughout and never bilobed C. isorealis
5. Pale spot in anal cell close to vein Cu_1 , in wing, bilobed C. subrosalis
6. Hind tibia with basal paleness extending almost to its middle, the part therefore being mostly pale; in wing, paleness in anal cell close to vein Cu_2 as 2 separate spots C. navaroceli
6. Hind tibia with a very small pale spot at base, the part therefore looking mostly dark; in wing, paleness in anal cell close to vein Cu_2 as one bilobed spot C. rosalis

7. Scutum dark with thick sublateral vittae and a pair of small, roundish dark spots in caudoscutal area; scutellum and post-scutellum dark brown C. pseudoregalis
8. Scutum pale with very slender sublateral vittae and caudoscutal area totally pale; scutellum and postscutellum also mostly pale. C. quasiregalis
9. Paleness at wing base extensive, invading anal cell; aedeagal stem long with ball-like tip C. innocuus
10. Paleness at wing base small, vague though slightly extending to anal cell; aedeagal stem very small, shorter than aedeagal arm with truncate, flat tip C. subinnocuus

Subgenus Diphacomyia Vargas, 1960:49

(Type of the subgenus : Caligoides baueri Hoffman, by original design.)

General characters : wing usually with second radial cell dark to tip and with definite small pale spots, that in cell M_4 usually touches vein M_{3+4} ; costa short. Sensilla coeloconica usually upto antennomere X, only occasionally beyond that. Third palponere

swollen apical with moderately deep sensory pit. Spermathecae two developed, oval to elongate oval, with prominent sclerotized necks, a third rudimentary and a ring visible. Male genitalia usually with a pair of characteristic posterior sclerotized processes on the postero-lateral "shoulders" of aedeagus; parameres each with basal knob, subapical fringing hairs and often with median ventral lobe; its part caudad of the lobe sharply curved laterad; tergum IX with a pair of AP; basistyle with simple dorsal root and "boat-hook" shaped ventral root.

The 14 species of Gulicoides belonging to s.s. Dinhepavia are found to occur in the State of West Bengal and these may be placed under 4 known groups of species within the subgenus. The important characters of these groups are :

Clavipalpis Group : small sized, darkish midge; wing with prominent, though small, pale spots - at r-m lying completely distal to it and vein M_2 never engulfed by a pale spot, at best touched by such a spot; sensilla coeloconica never beyond antennomere X; HTC of 4, first from spur longest. Processes on aedeagal 'shoulder' free from aedeagal stem; parameres each with a ventral lobe at middle. male genitalia with parameres each having a ventral lobe at middle.

Haematopodus Group : wing often with prominent pale spots - second radial cell if pale is at extreme tip only; pale spot at r-m totally engulfs it and vein M_2 also often engulfed by a pale spot; sensilla coeloconica may be on antennomeres past X; HTC of

4-5; processes on aedeagal 'shoulder' free from aedeagal stem; male parameres each with or without a ventral lobe at middle.

Shortii Group : wing darkish grey with prominent pale spots, that at r-m broadly touching costa and usually a subapical pale spot in cell R_5 besides the apical one which touches wing margin; apical pale spot in cell M_1 simple, or bilobed or divided into two separate spots. Sensilla coeloconica on antennomeres III, VIII-X, rarely on V and VI also, but none beyond X. HTC usually of 5, second from spur longest. Male genitalia with aedeagus often having long arms and deep basal arch and aedeagal stem variously ornamented, the processes on aedeagal 'shoulder' looking associated more with the stem; parameres each slightly palmate subapically with fine fringing hairs.

Sinilis Group : wing darkish grey with prominent pale spots, that at r-m broadly touching costa though vaguely sometimes. Sensilla coeloconica on antennomeres III, V, VII - X, sometimes also on VI, but never beyond X. HTC of 5, first from spur longest. Male genitalia with aedeagal stem rather simple and processes of aedeagal 'shoulder', typical of e.g. *Diphonyia*, lacking; parameres each slightly palmate subapically in its outcurved part with fine fringing serrations.

A) CLAVIPALPIS GROUP OF SPECIES

Fullicoides candidus Sen and Dasgupta, 1959b:620
(Figs. 10 a-c)

Female : wing dark grey with about 12 very small, mostly roundish pale spots, those in cell R_5 to M_2 not touching wing margin. Legs brown with narrow, subapical pale bands on femora and subapical and subbasal pale bands on tibiae. Spermathecae two developed, elongate oval with long, sclerotized necks.

Male genitalia : aedeagal stem longish, slender with flat and blunt caudal tip plus slight preapical attenuation while its two much longer, equally slender arms are directed cephalad forming high aedeagal arch and a small conical process exists on aedeagal 'shoulder', parameres each with outcurved portion rather slender throughout and having at middle of its caudal aspect 3-4 serrations.

Distribution : India (Dum Dum and Thakurpukur, around Calcutta, West Bengal).

Specimens examined : 10 females, 7 males from type locality (Dum Dum) collected at light trap, and by breeding, during January 1957 - March 1958.

Comments : The present species very closely resembles E. clavipalpis Mukerji in body size and wing maculation. Wirth (1973) in fact declared the former as the synonym of the latter.

It is confirmed that such differences exist between the two - poststigmatic pale spot in clavipalpis as one foot-shaped spot but as two grossly unequal spots in candidus; distal pale spot in cell M_2 touching wing margin in clavipalpis but not in candidus, and finally, the aedeagal and paramere details of the two are grossly different. Therefore, C. candidus is upheld as a valid species. Dyce (1978) informs that the intricate details of the distal part of paramere of candidus fit adequately with the pertinent Australian forms.

Gulicoides clavipalpis Mukerji, 1931:18:1052.

(Figs. 10 d-f)

Female : third palponere enormously swollen from basal third distad and with a deep, sac-like sensory pit. Scutum brown with a darkish patch in the middle of front end, another at hind margin and with some 6 pale roundish to oval pale spots - the whole forming a colour pattern distinct in fresh specimens; scutellum pale with 4 large and 4 small bristles. Legs brown with pale basal/subbasal spots on all femora and tibiae. Wing darkish gray with wide basal paleness and some 9 small pale spots - the poststigmatic pale spot foot-shaped and retains this pattern even when divided as 2 spots occasionally, that distally in cell M_2 removed from margin; macrotrichia sparse, none in cell M_4 and anal cell. Spermathecae two developed, well sclerotized, elongate oval with long sclerotized necks.

Male genitalia : typical of the *Diphaomyia* Group, aedeagal arms slightly divergent, the stem thick parallel-sided with caudal tip blunt having minute overmarginal projections and parameres each in the middle of its outcurved portion swollen and having at caudal margin there 3-4 small needlelike processes.

Distribution : India (in and around Calcutta, Habra, Gobardanga, Taki, Chinsurah, Burdwan, Sonakanla and Siliguri, of West Bengal); Australia to Philippines and Thailand (Causey, 1938; Delfinado, 1961; Dyce (1978)).

Specimens examined : 12 females, 6 males, in slide-mounts, collected by B. C. Majumdar and S. K. Dasgupta at light trap during 1957 and 1968-70 from in and around Calcutta, Chinsurah and Burdwan.

Comments : According to Dyce (1978), samples of the present species of Australia examined by him show structural variation in paramere part of aedeagus. He finds past descriptions of the species by several authors inadequate or erroneous. It can be summarised from a perusal of literature that while on wing pattern, Sen and Dasgupta (1959b) and Dasgupta (1964) omitted the pale spot in cell M_2 just anterior to the medio-cubital fork, on male genitalia, Causey (1938) and other workers overlooked the characteristic posterior conical processes on the aedeagal 'shoulder' which Delfinado (1961) vaguely reported as "aedeagus with spines at basal arch". Admitting

descriptive errors thus, it is now held that clavinalis specimens of Sen and Dasgupta (1959b: 620) actually belonged to that species and were not of C. huffi Causey, as stated by Wirth (1973: 368).

A very comprehensive redescription of the present species is furnished by Majumdar and Dasgupta (1972) which is rechecked now and summarised. It appears that the present species differs from its allies by having the pale spot distal to $r-m$ small and not extended to first radial cell, poststigmatic pale spot foot-shaped and never touching vein M_1 , aedeagal tip flat but not smooth having small overmarginal projections and outcurved part of parameres palmate at middle with 3-4 spines.

Culicoides distinctus Sen and Dasgupta, 1959b: 618.

(Figs. 10 g-1)

Female : wing darkish grey with about 10 small pale spots resembling those of mukerjii Majumdar and Dasgupta, the difference being - the post-stigmatic pale spot in distinctus, in its lower half, turns away from second radial cell while in mukerjii, it passes below the cell; macrotrichia scanty but occur almost in all cell areas. Legs brown with broad subapical pale spots in femora and narrow pale spots at both ends of tibiae. Spermathecae as in mukerjii.

Male genitalia : basistyllic roots simple though prominent, dististyle showingly short and slender with sharply tapering caudal tip; aedeagus with lance-shaped, small processes on 'shoulder', the aedeagal stem rather long, parallel-sided and flat-tipped caudad; parameres each with outcurved part palmate with 5-6 serrations at tip, outer one longest.

Distribution : India (Dum Dum and other suburbs around Calcutta and inside Calcutta, West Bengal).

Specimens examined : 2 females, 1 male in slide-mounts, collected from Dum Dum in March 1958.

Comments : The present species seems to be a less common Culicoides having rather a limited distribution range. It closely resembles C. mukerji and it breeds in rotting banana vegetation in nature (Dasgupta, 1962b); however, it shows its differentiating features in wing spots and aedeagal and paramere details of male genitalia.

Culicoides mukerji Majumdar and Dasgupta, n.sp.,

1972 : 151.

(Figs. 10 j-1)

Female : frontovertex brown with more than 30 setae. Third palpomere enormously swollen to tip, with a deep subapical sensory pit. Scutum brown with paleness at anterolateral angles and at hind end conically; scutellum pale with 4 large and 12-16 small bristles.

Legs brown with subbasal pale spots on all tibiae, the femora showing basal paleness though not clearly with pale spot there. Wing darkish brown with about 8 small, prominently marked pale spots and paleness at base with veins M_1 and M_2 engulfed entirely by vague pale streaks; macrotrichia sparse, visible all over in cell R_5 but marginally in cell M_1 to anal cell. Halteres pale. Spermathecae two developed, subequal and subspherical to elongate oval with prominent necks.

Male genitalia : patterned as in G. clavipalpis Mukerji with noteworthy differences as - aedeagal stem longish and stout, its caudal tip slightly more so and convexly smooth, the two processes on aedeagal 'shoulder' long, rod-like; parameres each with outcurved part palmate with 6 serrations from caudal margin thereof, the outermost serration longest.

Distribution : India (Habra, Darjeeling and Kalimpong of West Bengal; Ranock of Sikkim).

Specimens examined : types and additional specimens, in slide-mounts, collected by S. K. Dasgupta and P. P. Choudhuri from above stated locations at light trap during 1969 and 1978.

Fig. 10. Culicoides candidus Sen and Dasgupta; a-c :

a, female wing; b, male aedeagus; c, male paramere.

Culicoides clavinalis Mukerji; d-f :

d, female wing; e, male aedeagus; f, male paramere.

Culicoides distinctus Sen and Dasgupta; g-i :

g, female wing; h, male aedeagus; i, male paramere.

Culicoides mukerjii Majumdar and Dasgupta, n.sp.;

j-l : j, female wing; k, male aedeagus;

l, male paramere.

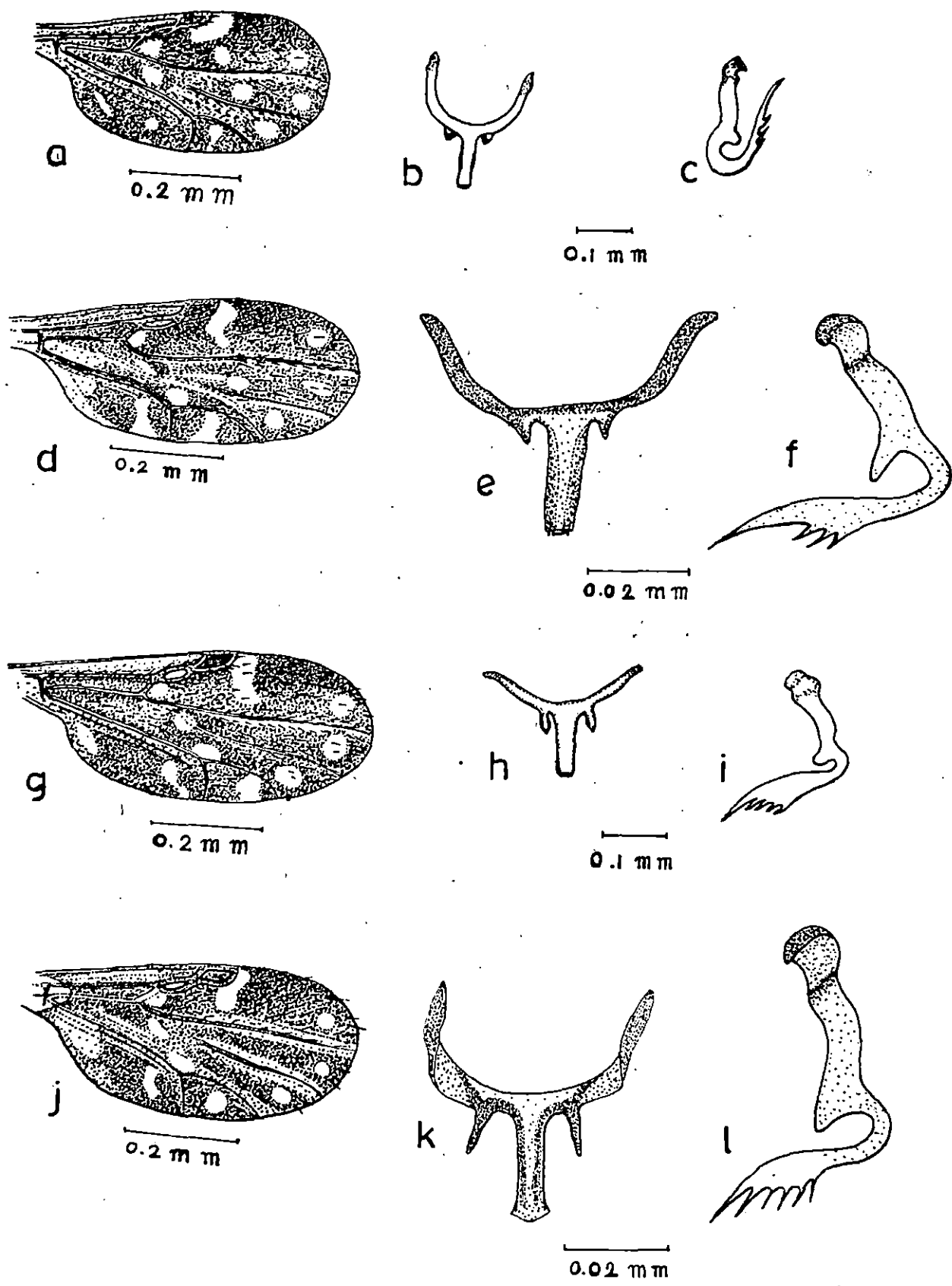


FIG-10

Comments : The present species closely resembles C. distinctus Sen and Dasgupta in wing maculation and paramere nature. Its aedeagus with slightly bulged, convex caudal tip of stem and rod-like, longish processes on aedeagal 'shoulder' are very distinctive.

B) HAEMATOPOTUS GROUP OF SPECIES

Gulicoides peculiaris Majumdar and Dasgupta, n. sp.,

1972 : 172.

(Figs. 11 a-c)

Female : sensilla coeloconica on III, VII - X, XII and XIV. Third palponere swollen appreciably subapical and with a sac-like, deep sensory pit. Brown scutum; scutellum pale with 3 large and 12 small bristles. Legs deep brown with subbasal pale spot on tibiae; HTC of 5, first from spur longest. Wing light brown with some 9 small to large-sized pale spots, paleness at base and along veins M_1 and M_2 apparent; macrotrichia abundant compared to the condition in comparable species - cell M_4 to anal cell showing them all over. Spermathecae two developed, sclerotized, elongate oval but grossly unequal and with extended sclerotized necks.

Male genitalia : patterned as in glavivalis with noteworthy differences as aedeagal arm flexed more than once and processes on aedeagal 'shoulder' thorn-like, long; aedeagal stem parallel-sided, thick with flat and even caudal tip; parameres each palmate distally of the outcurved part with 5-6 serrations, outer one slightly longer than others.

Distribution : India (Darjeeling, West Bengal).

Specimens examined : types 3 females, 1 male, in slide-mounts, collected from Govt. College Campus, Darjeeling, by Mr. F. Sharma at light trap during July 1968.

Comments : The present species has pale spots in wings quite peculiar in size - the distalmost pale spot in cell R_5 very small, round, and macrotrichia covering almost the whole of cell areas in cell R_5 to anal cell. Five spines in hind tibial comb and peculiar male genitalic features make it a distinct species.

C) SHORTTI GROUP OF SPECIES

Culicoides fortis Sen and Dasgupta, 1959b, 52:622.

(Figs. 11d-f)

Female : scutum brown, having a dark vitta along midline that thickens at both ends and with several pale spots; scutellum pale with 4 large and 4 small bristles. Legs dark brown with paleness at base of femora and apex of tibiae, with knees dark and having distinct pale bands on either side. Wing darkish grey with about 11 pale spots - at r-m, one large spot halfway in cell R_5 between poststigmatic pale spot and the apical pale spot; the apical pale spot in cell M_1 large but never bilobed or divided into two separate pale spots. Haltere knob yellowish. Spermathecae two developed, grossly unequal and elongate oval with prominent necks.

Male genitalia : patterned after Dinbaevia type with specialities as - slender dorsal root of basistyle very long and cephalad bent inwards into a pointed process; stem of aedeagus with caudal tip conically convex having finely serrated margin at whose middle a short, slender overmarginal projection, also finely serrated, is, seen and aedeagal 'shoulder' processes each drawn out cephalad into a tapering crooked part.

Distribution : India (Habra, Senakania and Siliguri of West Bengal; Naogaon of Assam).

Specimens examined : 8 females, 5 males including types (in slide-mounts), collected from several parts of West Bengal by S.K. Dasgupta at light trap.

Comments : The present species closely resembles C. shortti Smith and Sumanath to such an extent that Wirth (1973) preferred to treat it as the latter's synonym. On a scrutiny now, we are unable to accept this contention since in our view, the specialities of the present species stated above are enough to admit it as different from C. shortti, which we also find colaterally distributed in the West Bengal plains.

Colicoides shortii Smith and Swaminath, 1932, 25:183.

(Figs. 11 5-1)

Female : scutum deep grey with pattern of colouration and scutellar bristles same as in C. fortis Sen and Dasgupta; so also femoral and tibial colouration. Wing darkish grey with pale spot pattern and macrotrichia as in C. fortis, the notable difference is that cell M_1 here bears 3 pale spots though the distal two smaller and separated by a broad shaded area. Haltere knob pale. Spermathecae two developed, subequal and elongate oval to pyriform with prominent sclerotized necks.

Male genitalia : patterned after Rinheomyia type with specialities as - dorsal root at its cephalic end never bent inwards, stem of aedeagus with its caudal tip frayed into uneven flat margin, never conical in appearance, and processes of aedeagal 'shoulder' each extended caudad along stem margin to terminate finally to a laterally bent short thorny part.

Distribution : India (Gauhati, Naogaon of Assam; Habra, Gobardanga, Ranigunj, Siliguri of West Bengal), Cambodia, Java, Laos, Malaya, Thailand and Vietnam (Wirth, 1978).

Specimens examined : INDIAN FORMS : 12 females, 7 males from Habra, Gobardanga and Siliguri, collected by S. K. Dasgupta and P. P. Choudhuri at light trap during 1966 and 1968 - all slide-mounts. EXOTIC FORMS : 2 female slide mounts, specimens of Thailand received from Dr. Wirth.

Comments : The present species seems to be more common in occurrence than its sympatrically distributed, closely related form G. fortis Sen and Dasgupta from which it can be separated by the pale spot pattern in cell M_1 of wings, by subequal or grossly unequal state of spermathecae and by male genitalic differences.

Gulicoides smithi Majumdar and Dasgupta, n. sp.

1972 : 215

(Figs. 11 j-l)

Female : scutum deeply greyish with colour pattern as scutellar bristles as in G. fortis Sen and Dasgupta; so also colouration of femora and tibiae. Wing smoky-shaded with pattern of pale spots and macrotrichia as in G. fortis; cell M_1 shows 2 pale spots, the distal one bilobed. Haltere knob pale. Spermathecae two developed, subequal, subspherical to pyriform with prominent sclerotized necks.

Male genitalia : patterned after Diphocomyia type with specialities as - slender dorsal root of basistyle like that in G. fortis very long and cephalad bent inwards into a pointed process; stem of aedeagus with small conical serrations at its tip and the processes of aedeagal 'shoulder' each as a slender, small, straight part; outcurved portion of each parameres slender, nowhere palmate and with fine subterminal fringing hairs.

Distribution : India (several parts of West Bengal).

Fig. 11. Calicoides neoculicaris Majumdar and Dasgupta, n.sp.;

a-c: a, female wing; b, male aedeagus,
c, male paramere.

Calicoides fortis Sen and Dasgupta; d-f :

d, female wing; e, male aedeagus;
f, male paramere.

Calicoides shortti Smith and Swaminath; g-i:

g, female wing; h, male aedeagus;
i, male paramere.

Calicoides smithi Majumdar and Dasgupta, n.sp.;

j-l : j, female wing; k, male aedeagus;
l, male paramere.

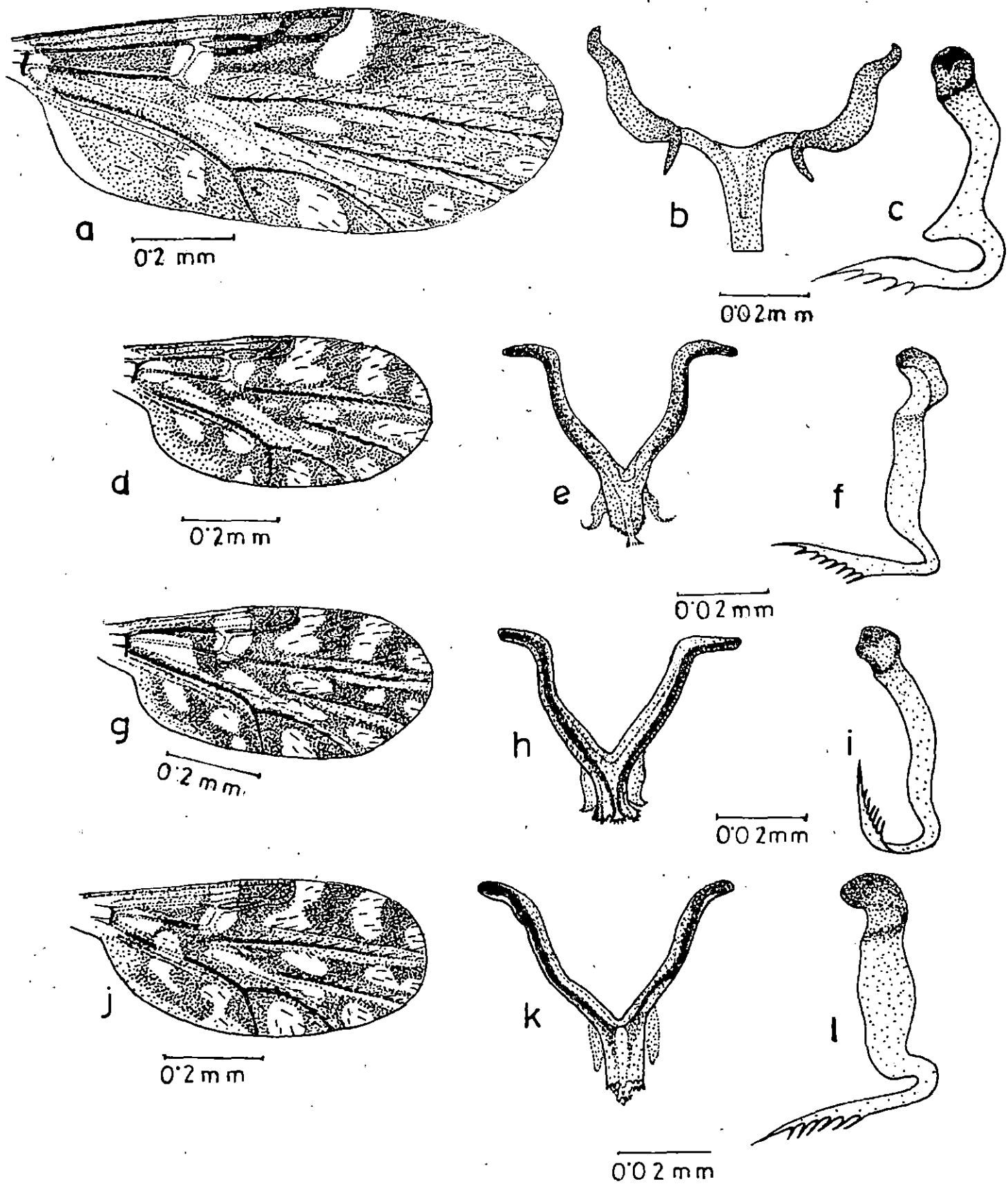


FIG.-11

Specimens examined : 8 females, 2 males including types, all collected from Chinsurah, Gobardanga, Habra, Ranigunj and Siliguri by B. C. Majumdar and S. K. Dasgupta at light trap during 1966.

Comments : The present species also seems to occupy the typical distribution range of its allies in the Shortti Group of the S.G. Diphaguvia. Its aedeagal stem and 'shoulder' processes alongwith the bilobed pale spot distally in cell M_2 distinguish it consistently.

Calicoidea subnotatus Majumdar and Dasgupta, n. sp.,

1972 : 223.

(Figs. 12 a-c)

Female : blackish grey frontovertex with about 15 setae. Sensilla coeloconica on III-X. Third palpus enormously large and inflated with an equally big sensory pit past middle. Scutum brown with a conical darkish patch at hind margin, a small darker medial patch at front margin plus a few small pale spots. Leg colouration as in C. shortti; HTC of 4, first from spur longest. Wing brownish with about 10 pale spots - cell M_5 with only 2 such spots with no subapical spot and apical pale spot reniform. Haltere knob pale. Spermathecae two developed, unequal, pyriform to elongate oval and with very prominent sclerotized necks.

Male genitalia : patterned as in its related forms with peculiarities as : aedeagal arms rather short though slender and straight to their tips cephalad, the aedeagal stem itself a simple, short rod-like process with tapering caudal end devoid and serrations

merges at base with the aedeagal 'shoulder' processes such that the whole appear as a trident; parameres each with outcurved part slightly palmate distad having about 9 fringing hairs.

Distribution : India (Bankura town, Chinsurah, Diamond harbour, Habra, Itachuna, Purulia, Raniganj of West Bengal; Behri-on-Sone of Bihar).

Specimens examined : 15 females, 5 males including types, collected from Habra, Itachuna and Bankura town of West Bengal by S. K. Dasgupta at light trap during 1967.

Comments : The present species seems to be a common element in all places of its occurrence which is quite extended. It closely resembles C. notatus Delphinado described from the Philippines, but it is distinct by the differential make up of its pale spots especially that at apex in cell R_5 which is clearly reniform. The nature of its aedeagus of male genitalia also differs from its other allies as the aedeagal stem simply looks like a trident with the aedeagal 'shoulder' processes.

Calicoidea swaminathi Majumdar and Dasgupta, n.sp.,

1972 : 232.

(Figs. 12 d-f)

Female : Third palpomere swollen at middle and then tapers distad, with a shallow sensory pit. Frontovortex, scutum-scutellar nature and leg colouration as in subnotatus Majumdar and Dasgupta. Wing colouration patterned as in shorti, but distal pale spot in

cell surface. Haltere knob pale. Spermathecae two developed, grossly unequal, subpherical to elongate oval and with very prominent sclerotized necks.

Male genitalia : patterned as in G. fortis Sen and Dasgupta, but with specialities as : aedeagal arms slender, long, broadly divergent with basal arch low and cephalic end of each arm sharply bent laterad and caudad; aedeagal stem with caudal margin concave, finely serrated and having an overmarginal process at middle; processes at aedeagal 'shoulder' each drawn caudad tapering with extreme tip filiform and bent laterocephalad; parameres each devoid of any preflexural lobe, its outcurved portion slim throughout with about 7 large to small subapical fringing hairs.

Distribution : India (Gobardanga, Habra and Taki of West Bengal).

Specimens examined : 2 females, 2 males including types from Habra and Taki of West Bengal, collected by S. K. Dasgupta at light trap during 1967.

Comments : The present species is rather a less common element in its place of occurrence which seems rather limited. It is distinguished by its larger pale spots and peculiar aedeagal details.

D) SIMILIS GROUP OF SPECIES

Colicoidea causeyi Majumdar and Dasgupta, n. sp.,

1972 : 101

(Figs. 12 g-1)

Female : antenna brown with segments pale basad, proximal ones subglobular, very small but distal ones cylindrical, elongated though tapered apicad; sensilla coelocenica on III, V, VII-X. Third palposere enormously swollen with a large, shallow sensory pit. Scutum brown with a median vitta extending apicad from the conical darkish patch at hind margin; scutellum with 3 large and 6-8 small bristles. Leg colouration as in other group species of subgenus Rhaphomyia; HTU of 4, first femur spur longest. Wing brown with some 11 pale spots, the poststigmatic and the apical pale spots in cell R_5 and that at r-m round, small; macrotrichia sparse but in whole of cell R_5 and exists even in anal cell. Spornathecac two developed, slightly unequal and elongate oval with very prominent necks.

Male genitalia : patterned after Rhaphomyia species, the specialities being : aedeagus with arms and stem look like a triradiate body, the two arms straight, divergent while the stem at tip swollen, concave-margined and smooth the 'shoulder' processes lacking; parameres each with outcurved part slightly palmate, bent and with about 5-6 fringing hairs of equal size.

Distribution : India (Bagati, Gobardanga, Habra, Itachuna and Siliguri of West Bengal).

Specimens examined : 8 females, 5 males including types, all collected by B. C. Majumdar and S. K. Dasgupta at light trap during March - May 1967 and in July 1968.

Comments : The present species resembles G. huffi Causey described from the Philippines, Thailand and India. Its distinctions are : apical pale spot in cell R_2 separated from wing margin, male genitalia with non-emarginate, flat caudal margin of IX sternum and caudal tip of aedeagal stem concaved such as to appear double-headed whereas in G. huffi, it is double-pointed.

Gulicoides distinctivalis Majumdar and Dasgupta, n. sp.,

1972 : 116.

(Figs. 12 j-1)

Female : sensilla coeloconica on III-X. Third palpomere disproportionately large and swollen compared to II, IV-V palpomeres which are strikingly short. Scutum light brown with two sublatera darkish lines, other two such proceeding from two ends of its hind margin converge at distal third ahead of which a darkish colour patch visible; scutellum pale with 4 large, 4 small bristles. Leg colouration and spines in hind tibial comb usual. Wing brownish, with no pale markings; two radial cells small (first virtually without a lumen) and a small, roundish poststigmatic pale spot often apparent; macrotrichia abundant, even in anal cell. Spermathecae two developed, slightly unequal, pyriform with very short, sclerotized necks.

Male genitalia : specialities being - aedeagus with long, divergent arms which are almost straight throughout the aedeagal stem half of the length of its arm but very stout and ends caudad in a conically narrowed, smooth-margined; no 'shoulder' processes in aedeagus; parameres each with the outcurved part slightly palmate subapically with a few fringing hairs, an unusual feature being a membranous expansion at base of this outcurved part with one serration process at its outer margin.

Distribution : India (Bankura, Burdwan, Chinsurah, Habra, Itachuna, Raniganj and Siliguri of West Bengal; Dehri-on-Sone, Bihar).

Specimens examined : 15 females, 8 males including types, collected by P. K. Choudhuri during 1967-1968 at light trap.

Comments : Wing colouration with only the poststigmatic pale spot apparent and abundant surface macrotrichia in wing together with unusual nature of the maxillary palp (third palponere enormously broad and long compared to second, fourth and fifth palponeres which are very short) and of aedeagus and parameres of male genitalia make this species an outstanding one in all known Dirhaonyia. Its geographical distribution seems extended and it is a common element in most places of its occurrence.

Culicoides huffi Causey, 1938, 27:406.

(Figs. 12 a-c)

Female/: sensilla coeloconica on III, V, VII-X. Third palpomere enormously broad at middle with a large sensory pit apicad. Scutum brownish with medial area of front margin darkish and showing a tendency of a vitta formation; two sublateral linear darkish impression with a few small, roundish pale spots apparent; scutellum with 3 large and 4-6 small bristles. Leg colouration and hind tibial comb as in causeyi. Wing brown with 11 pale spots, mostly small sized but clearly impressed; macrotrichia mostly in cell R_5 with a stray few occurring down to cell M_4 . Spermathecae two developed, suboval and subequal with long sclerotized necks.

Male genitalia : patterned after causeyi with specialities as - sternum IX flat at caudal margin; aedeagal stem at tip structured such as to have a very small medial overprojection and two angles drawn into two pointed processes.

Distribution : Thailand; India (Burawan, Chinsurah, Diamond Harbour, Gobardanga, Habra and Itachuna of West Bengal; Puri of Orissa State) and the Philippines (Delphinado, 1961).

Specimens examined : INDIAN FORMS - 12 females, 10 males from 24 Parganas locations, collected by B. C. Majumdar and S.K. Dasgupta at light trap during 1965-1967. EXOTIC FORMS - 6 female and 2 male slide-mounts, received from Dr. Wirth (Thailand samples).

Comments : Some drawbacks and discrepancies in the description of the present species in literature are noted. Basing on labelled slide mounts of Dr. Wirth and comparable material from our area that we take as samples of the present species, we confirm its occurrence in India as distinct from its close ally G. causeyi Majumdar and Basgupta.

Colicoides sigilla Carter, Ingram and Macfie,

1920, 14: 255.

(Figs. 12 p-6)

Female : darkish brown frontovertex with about 50 setae. Sensilla coelotonica on III, V-X. Third palponere large, enormously swollen with a deep sensory pit. Scutum, brown, 4 large and 4 small bristles in scutellum. Leg and wing colouration as in other species of the Sinilis Group, vein M_2 engulfed at middle by pale areas and pale spot at r-m such that first radial cell is almost totally engulfed by it; macrotrichia in wing surface fairly enough in cell R_5 to anal cell. Spermathecae two developed, unequal and elongate oval with prominent sclerotised necks.

Male genitalia : patterned as in huffi Causey with specialities as - aedeagal stem long, tapering caudad into needle-like termination and aedeagal arms each also long and slender; parameres each with outcurved part just palinate, the fringing hairs in an apical group of 4 hairs and a basal of 2 hairs - a gap apparent between these groups.

Distribution : Africa, India (Burdwan, Chinsurah, Gobardanga, Habra, Itachuna, Raniganj, Siliguri, Sonakania in West Bengal; Dohri-on-Sone in Bihar; also Andhra Pradesh, Madras and Mysore), Iraq, Malaya and Thailand (Smith and Swaminath 1932, Buckley 1938, Causey 1938, Fiedler 1951, Gutsevich 1959-1969, Nagatty and Morsey 1960, Najundar and Dasgupta 1972, Pooran and Dipeolu 1979).

Specimens examined : 20 females, 15 males from several parts of West Bengal, collected by S. K. Dasgupta at light trap during 1957, 1964-1971.

Comments : The needle-like caudal part of the aedeagal stem, abundant setae in the frontovertex, enough macrotrichia in wing surface and first radial cell almost totally engulfed by the pale spot at r-m etc., characterise the present species. It is a very common element in its place of occurrence whose range again is very extensive.

Fig. 12. Gulicoidea subnotatus Majumdar and Dasgupta, n. sp.;

a-c : a, female wing; b, male aedeagus;
c, male paramere.

Gulicoidea sushinathi Majumdar and Dasgupta, n. sp.;

d-f: d, female wing; e, male aedeagus;
f, male paramere.

Gulicoidea gauseyi Majumdar and Dasgupta, n. sp.;

g-i : g, female wing; h, male aedeagus;
i, male paramere.

Gulicoidea distinctivalis Majumdar and Dasgupta, n. sp.;

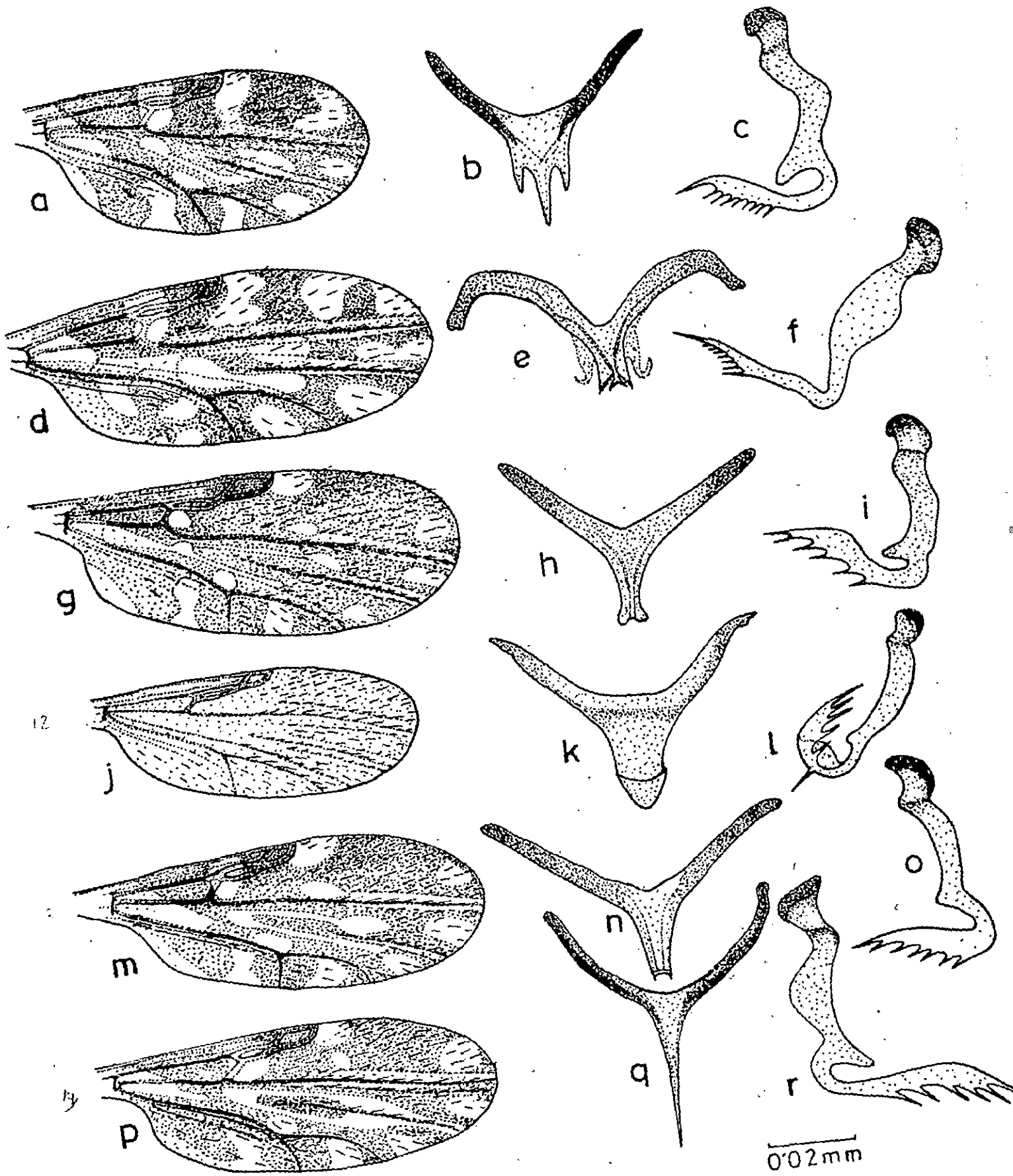
j-l : j, female wing; k, male aedeagus;
l, male paramere.

Gulicoidea huffi Gausey; m-o :

m, female wing; n, male aedeagus;
o, male paramere

Gulicoidea similis Carter, Ingram & Macfie; p-r :

p, female wing; q, male aedeagus;
r, male paramere.



0.2mm

0.02mm

FIG-12

KEY TO WEST BENGAL SPECIES OF SUBGENUS DIPHAONYIA

1. Wing with several clearly defined pale spots - that at r-m small and roundish and, like distal most pale spot in cell R_5 , never extends to costal margin; poststigmatic pale spot usually as one large pale spot extending down, crossing the level of second radial cell. Aedeagal 'shoulder horns' as a pair of small, conical or subconical processes, the aedeagal stem free from them; a paramere always with a prominent preflexural ventral lobe in its middle; basistyllic dorsal root not longer than its ventral root 5 (Clavinalgia Group)
2. Wing with several clearly defined pale spots - that at r-m large, engulfing it and, like two or three pale spots in cell R_5 , extends to costal margin; poststigmatic pale spot usually as one large pale spot extending down, crossing the level of second radial cell. Aedeagal 'shoulder horns' as a pair of thick-based processes intimately with the aedeagal stem; a paramere usually lacking in the preflexural ventral lobe in its middle; basistyllic dorsal root slender, longer than its ventral root... 6 (Shortti Group)

2. Wing almost totally shaded or with several clearly defined pale spots - that at r-m various, either absent or as a small, round pale spot not engulfing r-m or as a large pale spot, like two pale spots in cell R_5 , engulfing r-m and extending to costal margin; poststigmatic pale spot does not extend down, crossing the level of second radial cell, and overlies a much smaller pale spot. Aedeagal 'shoulder horns' lacking; a paramere always with a variable preflexural ventral lobe in its middle; basitelylic dorsal root hardly longer than its ventral root

..... 10 (Sinilis Group)

3. Wing with several clearly defined pale spots - that at r-m large, engulfing it and extending to costal margin; the distalmost pale spot in cell R_5 very small and removed from wing margin while the poststigmatic pale spot large and extends down, crossing the level of second radial cell. Aedeagal 'shoulder horns' as a pair of small, slender processes, the aedeagal stem free from them and shows a smooth, flat caudal margin; a paramere always with a prominent preflexural ventral lobe in its middle; basitelylic dorsal root less stout and shorter than its ventral root ... S. peculiaris (Macrototus Group)

3. Wing with cell M_1 showing just one small, roundish pale spot 4
4. Wing with 2 small, roundish pale spots in the corresponding area 5
4. Poststigmatic pale spot in its lower half turns away from second radial cell; larger ridge with only 4 scutellar bristles; 'shoulder horns' of aedeagus small, lance-shaped and stem of aedeagus with caudal tip flatly blunt without any terminal inflation *G. distinctus*
4. Poststigmatic pale spot in its lower half turns towards second radial cell and passes below the cell; smaller ridge with 4 large and 12-16 small scutellar bristles; 'shoulder horns' of aedeagus slender, longish and never lance-shaped while stem of aedeagus with its caudal tip flatly blunt but inflates terminally at tip *G. dukerli*
5. Poststigmatic pale spot as one foot-shaped spot and even if broken into two spots occasionally, these are more or less equal and together retain the pattern; aedeagal stem not parallel-sided, without preterminal swelling caudad and the outcurved part of a paramere swollen at middle *G. slavinalis*

5. Poststigmatic pale spot as one large spot touching second radial cell and costa, never foot-shaped and overlies a much smaller pale spot; aedeagal stem parallel-sided, with preterminal slimming caudad and the outcurved part of a paramere similarly slender throughout and does not show any swelling C. candidus
6. Wing with cell R_5 showing no additional pale spot halfway in between poststigmatic and apical pale spot C. subnotatus
7. Wing with cell R_5 showing one additional pale spot halfway in between poststigmatic and apical pale spot ?
7. Wing with cell M_2 showing 3 disparate pale spots in a row C. shortti
8. Wing with only 2 disparate pale spots only in cell M_2 8
8. Wing with pale spots relatively larger and not much dissimilar in size; aedeagal arms strongly divergent, basal arch of aedeagus being low C. graminathi
9. Wing with pale spots relatively smaller and dissimilar in size; aedeagal arms slender, very long and not widely divergent, basal arch of aedeagus being high 9

9. Distalmost pale spot in cell M_2 clearly bilobed; 'shoulder horns' of aedeagus straight, simple and directed caudad .. *E. smithi*
- .. Distalmost pale spot in cell M_2 never bilobed; 'shoulder horns' of aedeagus divergent laterad terminally as crooked, filiform processes *E. fortis*
10. Wing almost totally shaded, at best a small poststigmatic pale spot apparent; macrotrichia scattered almost in the whole of surface of cell R_5 to anal cell.. *E. distinctivalis*
- .. Wing with several clearly defined pale spots and not totally shaded with only the poststigmatic pale spot apparent..... 11
11. Wing with pale spots mostly small - that at r-m hardly engulfs the vein and the pale spot rs in cell R_5 underlying the poststigmatic pale spot so small that it looks far removed; aedeagal stem with its caudal margin concave and produced into two double bell-like endings at two angles... *E. caudavi*

- Wing with pale spots not as in causoxi;
 aedeagal stem with its caudal margin concave
 and produced into two very short needle-like
 endings at two angles G. huffi
- Wing with pale spots not as in causoxi;
 aedeagal stem produced caudad as a whole
 into a long needle-like process G. similis

Subgenus Hoffmania Fox, 1948, 16:21

(Type of the subgenus : Gulicoides incallina Fox and
 Hoffman, by original design.)

General characters : wing with distinct pale spots - second radial
 cell ending in a pale spot, base of cell M_4 (bordering bases of
 veins M_{3+4} and Cu_1) pale with apices of veins M_1 , M_2 , M_{3+4} and Cu_1
 also pale, Sensilla coeloconica on antennomeres III, XI-XV, Third
 palpus slender and usually without a definite sensory pit, Hind
 tibial comb of 5-6 spines, Spermathecae two developed, intensely
 sclerotized, Male genitalia with AP small or none; basityllic
 ventral root undeveloped; aedeagus with an internal, sclerotized
 peg-like process at middle and aedeagal stem with its caudal tip
 spherical; parameres separated or fused at base into a plate with
 filamentous spinose tip caudad.

Only one species of this primarily Nearctic subgenus is known so far from West Bengal, the species not being placeable in usually referred subgenus Culisoides which has the base of cell M_4 dark. It is included in the Peregrinus group.

Peregrinus Group : large to medium dark coloured midge; wings with infuscation very deep above the level of medial vein; male genitalia with parameres separated from each other, their caudal parts tapered to filiform process bearing small spines at extreme tip.

A) PEREGRINUS GROUP OF SPECIES

Culisoides peregrinus Kieffer, 1910, 2:191.

(Syns. judicandus Bezzi, gamonati Salm, philippinensis Kieffer peregrinus var. assamensis Smith and Swaminath, oxytoma of Patel 1921, lunchiensis Chen and Tsai)

Female : dark, blackish and large-sized midge with a v-shaped mark on scutum. Sencilla coeloconica on III, XI-XV and XV having its distal end into a elongated nipple-like process. Third palpomere slender, with sensory pit represented by one or two small, irregular lined depression. Wing brownish grey, costa well past middle, with about 11 or 12 pale spots; distalmost pale spots in cell R_5 to anal cell not touching wing margin; macrotrichia scanty and near wing margin. Haltere with blackish stem and dull white or yellowish white knob in fresh state. Legs dark brown with subapical and subbasal pale bands on middle femora and last two tibiae but subapical pale band

only on fore femora and tibiae; HTC of 6, second from spur longest. Spermathecae two developed, elongate oval, unequal with prominent sclerotized necks.

Male genitalia : sternum IX with slightly depressed caudal margin, tergum IX tapering towards caudal margin which is slightly inundated at middle and with a pair of very rudimentary AP; basistyle with hairy inner margin, internal roots short; aedeagus with short, divergent arms and longish, slender stem, finely rounded at tip; parameres each tapering caudad to a fine spinose tip.

Distribution : India (Puri and Chilka Lake area of Orissa, several parts of West Bengal, Assam and Andhra Pradesh); Malaya, Philippines, China, Japan and Korea, Taiwan, Thailand and New Guinea.

Specimens examined : 25 females, 15 males collected from several parts of West Bengal (in and around Calcutta, Belpur, Jhargram, Anta, Konnagar and Uluberia, and Waltair), collected by S.K. Dasgupta at light trap during 1958-1960.

Comments : The present species enjoys a very wide geographical distribution (Wirth and Hubert, 1961) and is a common element of the Indian plains. The three *Culicoides* species esoneoti, judicandus and philippinensis were sunk as its synonyms by Macfie (1937c) while lungchiensis from China was found conspecific with it by Wirth (1973) who also contended that var. assamensis Smith and Swaminath of negrepinus could not be taken as any stable variety.

Subgenus Meijorechelea Wirth and Hubert, 1961, 3:23

(Type of the subgenus : Geratorogon cuttiflor de Meijore,
by original desig.).

General characters : wing with faint or distinct pale spots - second radial cell dark to tip or extreme tip of vein R_{4+5} pale; cell R_3 at least with a pale spot at poststigmatic zone and a distal pale spot, sometimes an additional one posterior to the junction of radial cells; each of cell M_1 and M_2 has 2 pale spots and anal cell has a pale spot proximally but 2 separate or one bilobed pale spot near margin; macrotrichia more or less abundant. Scabella coeloconica variously distributed in antennomeres III-IV, never restricted to III-X only. Spermatheca single, sclerotized and usually with narrow opening to duct, a rudimentary spermatheca and a ring absent. Male genitalia with well developed AP in tergum IX, aedeagal arms stout, the stem also fairly stout usually flaring at tip caudad; parameres usually separate, at best with a connecting bridge at subbasal region, basal knob directed laterad, stem short, simple and rather stout its tip without fringing hairs.

Only 4 species of Gulicoides are so far known in this subgenus, from West Bengal. These are placeable in 3 groups as follows :

Cuttiflor Group : wing with rather distinct small pale spots, cell R_3 with 3 pale spots - one at extreme tip, 2 in poststigmatic region and sometimes an additional fourth pale spot may be present posterior to the junction of radial cells; male genitalic parameres

completely separate with very large basal knob and aedeagus shows remarkably flaring tip.

Hegneri Group : wing with somewhat faint, though large pale spots - cell R_5 with 2 or 3 pale spots, one at extreme tip and others in poststigmatic zone. Sensilla coeloconica missing from IV-X antennomeres; male genitalia parameres separate or slightly fused at sub-base with small basal knob and aedeagus with flaring emarginate or finely rounded tip.

Unicalatus Group : Wing mostly pale, single shaded area covering only the basal cell and the two radial cells. Male genitalia with no apparent AP_1 , basistylus internal roots also not apparent and while parameres are typical of the subgenus, the aedeagus bears slender arms and stem.

A) GUTTIFER GROUP OF SPECIES

Gulicoides arakawai (Arakawa)

Caraterexon arakawai Arakawa, 1910, 14 : 411.

Gulicoides arakawai (Arakawa), Arnaud, 1956, 21 : 92.

Gulicoides arakawai (Arakawa), Sen and Dasgupta, 1959,

52 : 624.

Female : brown frontovertex with 15 setae. Sensilla coeloconica on III-XIV. Third palpomere swollen so as to appear conical in distal third; a moderately deep sensory pit subapical. Scutum brown with 5 pairs of small, roundish pale spots forming a characteristic pattern.

Legs brown with a clear, subbasal pale spot on all tibiae only, femora vaguely pale basad; HFC of 5, first from spur longest. Wing brownish with about 13 small but clearly marked pale spots - after typical Maljorchelean pattern. Spermatheca single, elongate, very large and gradually narrowed to broad duct.

Male genitalia : sternum IX with a shallow caudomedian excavation, tergum IX bears a pair of AP; dististyle tip pointed and highly infuscated; aedeagus with short, slender arms directed laterad and caudad, aedeagal stem also short ending in a flaring, hyaline bulged tip; parameres each with a laterally directed, massive basal arm and slender stem gradually tapered caudad to a rather stout, simple and bare tip.

Distribution : Japan; Borneo, Burma, China, India (Gauhati of Assam; Burdwan, Chinsurah, Gobardanga and Habra of West Bengal), Malaya, Manchuria, Philippines, Soviet Middle Asia, Ryukyu Is., Thailand and Vietnam.

Specimens examined : INDIAN FORMS - 10 females, 7 males - collected from several parts of West Bengal by S. K. Dasgupta - during 1965-1968 at light trap. EXOTIC FORMS - 3 females, 1 male from Dr. Wirth.

Comments : Wirth and Hubert (1961) cite some 4 Fulicoides spp. (caucasiensis, albaguttatus, shinali and deleki) as synonyms of the present species and subsequently, Wirth (1975) included micropunctatus described from Java also as conspecific with it. Its Indian

records are due to Smith and Swaminath (1932), Sen and Dasgupta (1959b) and Majumdar and Dasgupta (1972), while its records outside India are to a number of workers including Kieffer (1921), Macfie (1937), Causey (1938), Tokunaga (1951), Wirth and Hubert (1961) etc.

B) HEGNERI GROUP OF SPECIES

Culicoides hegneri Causey, 1938, 27: 402.

Culicoides seni Majumdar and Dasgupta, 1972 : 192

(now synonymy).

Female : brown frontovertex with 12 setae. Sensilla coeloconica on III, XI-XIV only. Third palpi more moderately enlarged part middle, then tapering with a small sensory pit. Scutum light brown with 2 sublateral pale streaks and 2 or 3 pairs of small pale spots. Legs brown with femora very broadly pale basad, tibiae having narrow subbasal pale spot; HTG of 4, first longest. Wing light grey with about 11 small pale spots - that at r-m engulfs it extends to costa, poststigmatic pale spot at best engulfs tip of vein R_{4+5} . Spermatheca typical of subgenus - one only.

Male genitalia : typical of subgenus - aedeagal stem not flaring though thick, blunt and flat margined at caudad end while parameres separated, their caudal ends filiform and ending to blunt, bare point directed laterad.

Distribution : Malaya; Borneo, Java, India (Burdwan, Habra, Itachuna and Siliguri of West Bengal), Malaya, Philippines and Thailand.

Specimens examined : INDIAN FORMS - 10 females, 2 males, collected from several parts of West Bengal during 1967; EXOTIC FORMS - 6 females, 1 male from Dr. Wirth.

Comments : Wirth (1974) in a private communication informed of the very close similarity between G. hegneri and G. seni. The differences between the two, pointed by Majumdar and Dasgupta (1972) were found now on a re-study as variable in both; moreover, those were not of a gross magnitude. Therefore, both are now taken as conspecific and G. hegneri is recorded to occur in India as well.

culicoides magnithecalis Majumdar and Dasgupta,

1972 : 147.

(Figs. 13 a-c)

Female : deep brown frontovertex with about 10 setae. Sensilla coeloconica on antennomeres III, XI-XIV. Third palpomere short, tapered conically distad with a small, shallow sensory pit at broadest part past middle. Scutum brown with pale caudoscutal area and narrow darkish patch flanked by pale streaks at middle of front margin. Legs pale brown, without any paleness, unicolourous; HTC of 4, first longest. Wing greyish with about 12 pale spots, the marginal pale spot in each of cell R_5 to anal cell touching wing margin; macrotrichia fairly sufficient in almost all cell surfaces. Spermatheca single, enormously large, ovoidal, sclerotized lightly and with a very short narrow sclerotized neck.

Fig. 13. Culicoides narnithecalis Majumdar and Dasgupta, n.sp.;

a-c: a, female wing; b, male aedeagus;

c, male paramere.

Culicoides neohamatomus Majumdar and Dasgupta, n.sp.;

d-f: d, female wing; e, male aedeagus;

f, male paramere.

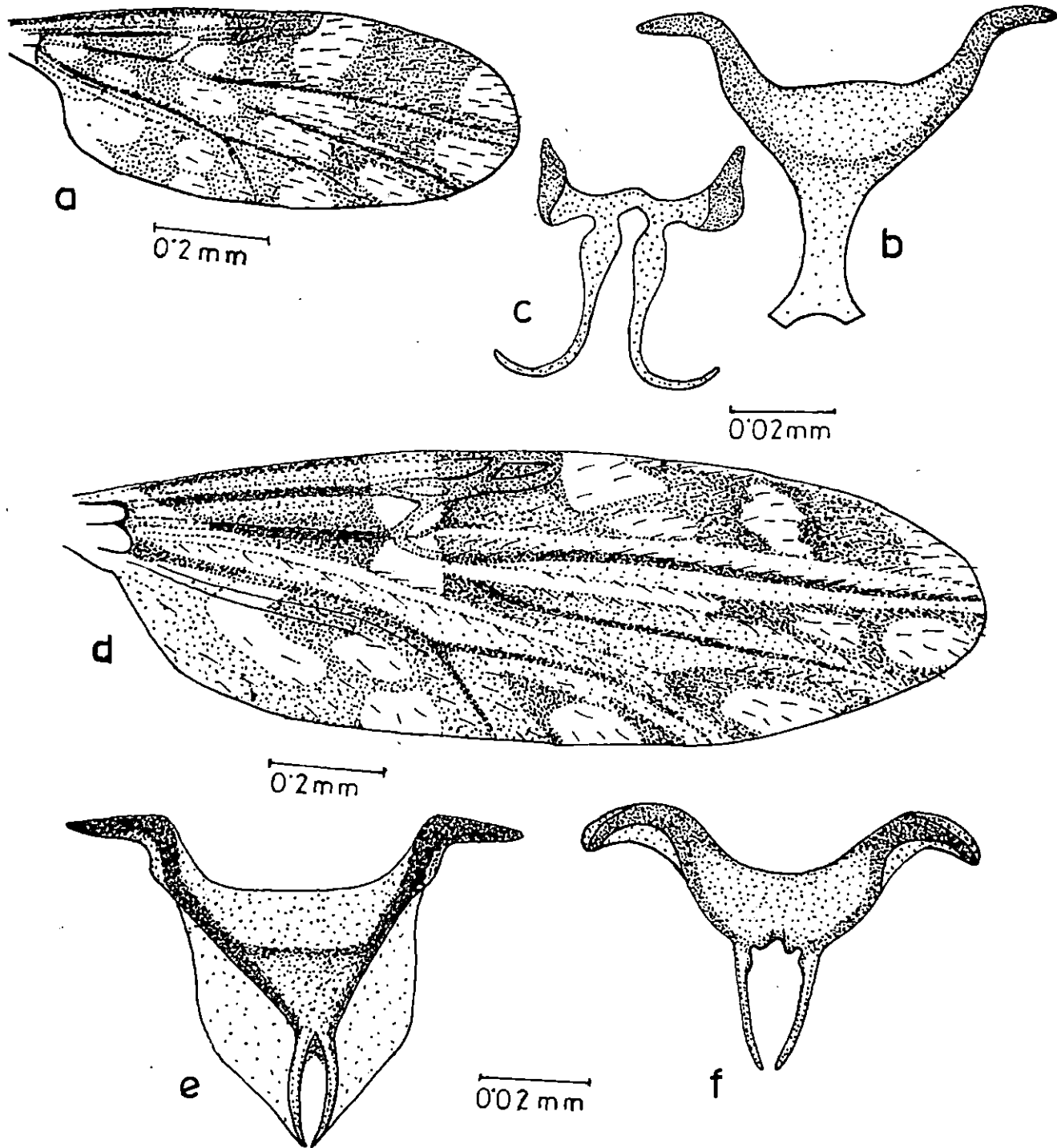


FIG-13

Male genitalia : sternum IX widely depressed at caudal margin; AP large, conical, tipped by a spine and almost meeting at the slightly cleft midregion of caudal margin of tergum IX; aedeagus with short, stout, divergent arms, its stem longish though stout with caudal characteristically inflated at tip; parameres joined at extreme base, each drawn caudad into a long, filiform process ending in a blunt tip.

Distribution : India (Siliguri, West Bengal).

Specimens examined : 2 females, 3 males including types, collected from Siliguri during June 12, 1963.

Comments : The present species though limited in distribution and less common is remarkable for some of its peculiar features and has no known related forms in Culicoides of India.

C) UNICALATUS GROUP OF SPECIES

Culicoides unicalatus, n.sp.

(Figs. 14a-c)

Female : wing length 0.83 (0.81 - 0.86, n = 6) mm; breadth 0.41 (0.39 - 0.44, n = 6) mm.

Head: frontovertex (fig. 14a) light brown with about 10 scattered setae all over it. Eyes narrowly separated; bare. Antennae (fig. 14b) brown, lengths of segments 3-15 in proportion of

Fig. 14. Culicoides unicalatus, n.sp.; a-o :

Female - a, frontovortex; b, antenna;
c, X and XI antennomeres;
d, maxillary palp; e, mandible;
f-h, legs; i, hind tibial comb;
j, wing; k, spermathecae;

Male - l, wing; m, genitalia (aedeagus
and parameres removed);
n, aedeagus; o, parameres.

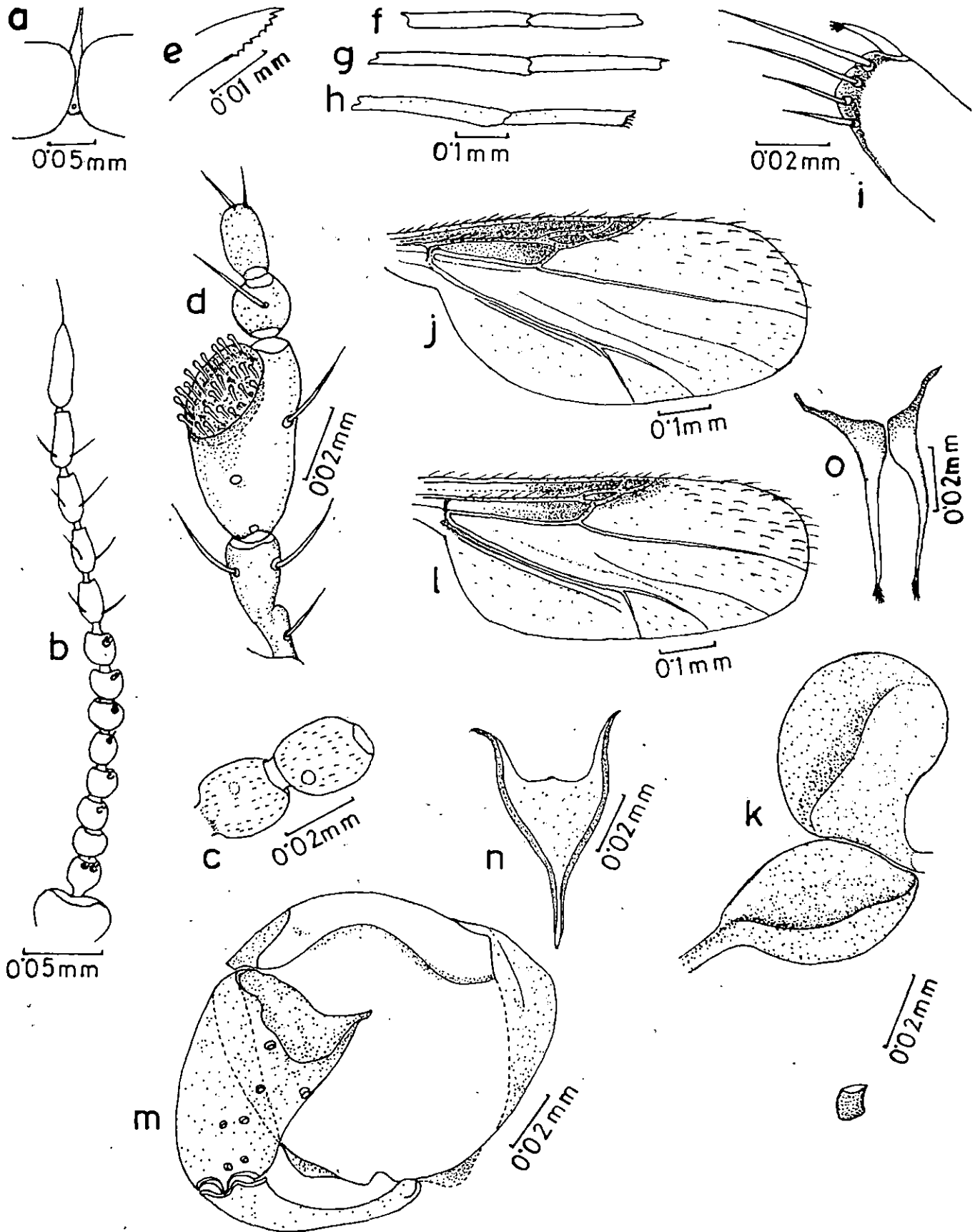


FIG-14

13.5 - 8.6 - 8.8 - 8 - 8.5 - 8.1 - 8.5 - 10 - 13.6 - 14.6 - 14.4 - 14.4 - 23.2; sensilla coeloconica present on segments 3, 5-10. Palpal segments (fig. 14d) with length in proportion of 9.1-13.5 - 20.6 - 6.5 - 8, third segment large, swollen progressively tapered, wide-mouthed, L/W ratio 1.74 (1.7 - 1.78, n = 6), shallow sensory pit; proboscis long, P/H ratio 1.59 (1.5 - 1.63, n = 6); mandible (fig. 14e) with 7-8 teeth).

Thorax : light brown; scutum brown, pattern not discernable in slide mounted specimen. Legs (fig. 14f-h) light brown, without pale bands; hind tibial comb (fig. 14 i) with 4 unequal spines, that nearest the spur longest, spur tip indistinctly frayed; tarsal ratio of hind leg 2.2.

Wing : (fig. 14j) with pattern as figured; light brown with grayish yellow spot in basal cell, radial cells first, second and other parts of wing uniformly pale brown, without markings; macrotrichia sparse, confined to apex of wing; radial cell moderately unequal, the second radial cell slit-like; costa extends to 0.54 (0.52 - 0.56, n = 6) of wing length. Halter knob and the base infuscated, otherwise light brown.

Abdomen : light brown, spermathecae (fig. 14 k) two developed, with internal sclerites; prominent necks, subequal, measuring 0.044 x 0.034 and 0.037 x 0.029 (0.046 x 0.038 - 0.032 x 0.028, n = 6) mm, ring present.

Male: General colouration similar to the female with usual sexual differences.

wing (fig. 14 l): Length 0.88 (0.86 - 0.90, n = 3) mm;
breadth 0.41 (0.38 - 0.46, n = 3) mm.

Genitalia (figs. 14 m-o) : Sternum IX with broad, shallow caudomedian excavation, ventral membrane not spiculate. Tergum IX subrectangular, apicolateral processes absent. Basistyle with well developed dorsal root; ventral root absent. Dististyle curved, shorter than basistyle, tapered distally to rather blunt tip. Aedeagus (fig. 14 n) with very short, out curved basal arms; body massive, feebly sclerotized, gradually tapered distad to slender, long stem with a single tip. Parameres (fig. 14 o) separated; with moderately angled, narrow, long basal arms and each slender stem tapered distad to filamentous, spinose tip.

Distribution : India (Burdwan, West Bengal State).

Type-data : Holotype female (Type No. Ent. Cs 1, PC2N), Burdwan area, August, 1978 by Dr. S. K. Dasgupta and the author at light trap; allotype male, same data as for holotype but May, 1978; paratypes 5 females and 2 males same data as holotype but March - September, 1978.

Discussion : The present species has wing colouration and configuration, distribution pattern of sensilla in antennomeres and male genitalic details conforming to those of subgenus Meijerehelea. So it is placed provisionally in this subgenus. It is named G. unicalatus for its very peculiar wing colouration, mostly pale, the shaded area covering only the basal cell and the two radial cells. The group name Unicalatus is now proposed for it as a new group in subgenus Meijerehelea.

KEY TO WEST BENGAL SPECIES OF SUBGENUS MEIJEREHELEA

1. Wing mostly pale, the shade area confined to basal and radial cells extending at best to costal margin
 G. unicalatus
2. Wing maculation not as above 2
2. Pale spots in wing rather large, the post-stigmatic one almost touching vein M_1 . Spermatheca disproportionately large but with a very short, narrow sclerotized neck. Male parameres fused mesad at extreme basal only, otherwise separate G. magnithecalis
2. Pale spots in wing rather small, the post-stigmatic one far removed from vein M_1 . Spermatheca large, its duct broad though unsclerotized from beginning. Male parameres totally separated 3

3. Cell R_5 with more than 2 pale spots, post-stigmatic pale spot overlying a separate smaller pale spot. Caudal tip of aedeagus enlarged C. arakawai
4. Cell R_5 with only 2 pale spots and no separate pale spot below post-stigmatic pale spot. Caudal tip of aedeagus not enlarged but flat and blunt C. hamneri

Subgenus Monoculicoides Khalaf, 1954, 47:46

(Type of the subgenus : Culicoides nubeculosus (Meigen),
by original design.)

General characters : Large sized ridge with widely separated, bare eyes. Wing usually with distinct light and darkish spots, second radial cell totally dark. Sensilla cocloconica on antennomeres III, VIII-X, and not beyond. Spermatheca single, sclerotized and large, its unscerotized neck narrow. Male genitalia with well developed, divergent AP, basistylic roots simple but prominent, dististyle abruptly tapered in distal half; aedeagus massive with bifid distal tip and parameres fused together mesad into a plate showing two slender, bare points caudad.

Only 1 Gulicoidea species is so far known in this subgenus, from West Bengal. It is placeable in the following group :

Homotonus Group : Wing brown with extensive pale areas, poststigmatic pale spot in cell R_5 wedge shaped, Spermatheca oval to elongate oval. Male genitalia with highly divergent AP and caudal points of aedeagus showing lateral flange.

A) HOMOTONUS GROUP OF SPECIES

Gulicoidea neohomotonus Majumdar and Dasgupta, n. sp.,
1972 : 156.

(Figs. 13 a-f)

Female : dark brown frontovertex with about 35 setae. Third palpomere long, gradually enlarged distad and with a small, shallow sensory pit. Scutum greyish pullinose. Legs dark brown with femora showing paleness basad and small subapical pale spot on first four femora only, all tibiae with narrow subbasal pale spot; HTC of 5, second longest. Wing brownish with extensive pale areas some of which shaped up as characteristic pale spots - poststigmatic pale spot subtriangular; macrotrichia sparse but in enough numbers in almost all cell surfaces. Spermatheca single, typical of the subgenus.

Male genitalia : typical of the subgenus, aedeagus drawn caudally into two slender processes slightly arched outward and a membranous patagium-like structure extends on each side of it from base to extreme caudal point.

Distribution : India (Siliguri, West Bengal).

Specimens examined : 1 female, 2 males, collected from Siliguri during April 2, 1958.

Comments : The present species seems to be limited in distribution and occurrence. It has no counterpart in the known Culicoides of West Bengal but it recalls several exotic Monoculicoides species, particularly homotomus Kieffer.

Subgenus Oecacta Fooy, 1851, 1:236.

(Type of subgenus : Oecacta furens Fooy, by monotypy).

General characters : The subgenus Oecacta, at its present standing, is an assemblage of heterogeneous species. It includes species with or without pale spots in wing, second radial cell completely dark to tip or pale at extreme tip, antennal sensoria present upto segment 10 or beyond 10, male parameres simple or with subapical fringing hairs, apicolateral processes highly developed or absent, ventral root simple or boat-hook shaped and aedeagus of widely various configurations. However, the diagnostic characters of the subgenus are as follows :

Pale spots in wing usually present or rarely absent; second radial cell usually dark to tip or at most extreme tip of vein R_{4+5} pale. Spermatheca sclerotized, usually developed two and rudimentary one. Male genitalia without any posterior sclerotized processes on the postero-lateral "shoulders" of aedeagus.

Some 14 species of Culicoides are so far known in this subgenus, from West Bengal. These are placeable in the following groups :

Chaetophthalmus Group : moderate size to large, uniformly brownish species with unmarked or poorly marked wings, wing length 0.95 - 2.30 mm. Eyes narrowly to broadly separated, with prominent pubescence between facets. Antenna with sensilla coeloconica present on segments 3, 11-19. Third palponere rather elongate, slightly expanded distally, with a large, shallow sensory pit. Mandible usually with 14-20 evenly spaced teeth; in 2 of the 6 known species mandible with rudimentary teeth. Mesonotum uniformly dark brown; scutellum with 4 large setae and a few small hairs. Legs uniformly brownish; HFC of 5-6, usually second longest; tarsi with ventral spinules rather well developed. Claws slightly asymmetrical, inner claw nearly straight, outer claw shorter, stouter and curved, this asymmetry more prominent on mid legs and more prominent in the female than in the male; prominent in annulosus, less so in other species. Wing with costa relatively long (costal ratio 0.62 - 0.68); 1st radial cell well developed, as long as 2nd; macrotrichia abundant, microtrichia strong. Two functional ovoid to pyriform spermathecae with short necks; a third rudimentary and a ring present. Male genitalia with well-developed AP; basistyllic roots simple, slender; aedeagus with curved basal arms, moderate basal arch, and slender, tapering

distal process; parameres with short, slender arms swollen proximal with bases contiguous or obscurely connected, straight and tapering distally to slender, pointed tip directed caudad.

Heliophilus Group : dull blackish midge. Wing uniformly milky white without any dark or pale spot; macrotrichia moderately abundant and whitish; costa, radius and veins bordering radial cells provided with strong blackish setae; a black stigma present over radial cells. Eyes widely separated. Legs dark. Sensilla coeloconica on antennomeres III-XV. Male genitalia with aedeagus of generalized type having broad, truncate and short stem; parameres with simple basal knob and smooth, slender tip without any midventral lobe.

Heavel Group : medium to large sized. Wing hairy, usually with distinct pale spots; pale spots in distal and midportion of wing often reduced; macrotrichia long and numerous. Sensilla coeloconica on antennomeres III, XI-XV, and sometimes additionally on the proximal series. Third palpomere broadly swollen with usually a deep sensory pit open by a smaller pore. Legs usually dark with pale rings; hind tibial comb with 4 spines, the one nearest the spur longest. Male genitalia with ventral root of basistyle simple, not boat-hook shaped; dististyle slender and pointed at tip; tergum ix usually broad and transverse caudally with long apicolateral processes; aedeagus usually with well developed basal arch and simple distal stem; parameres usually with well developed basal

arms directed laterad or antelaterad, the basal knob usually not very large, the stem usually slender and simple without mid-ventral lobe, the tip elongate, simple and sharp-pointed.

Schultzei Group : medium sized, with prominent mesonotal pattern. Wing with radial vein unbranched or incompletely branched and ending in a dark spot; pale spots small but distinct; no pale spot at tip of cell R_5 ; r-m crossvein entirely in a pale spot; apices of veins M_1 , M_2 , M_{3+4} and Cu_1 pale. Sensilla coeloconica distributed not beyond segment 10. Spermatheca subequal with prominent neck. Male genitalia having aedeagus with divergent, slender arms and truncate, emarginate distal tip; parameres separate with simple basal knob, gradually tapering to slender spinose tip; basistyle with well developed simple roots; tergum ix sharply narrowed distad with two finger like divergent apico-lateral processes.

A) CHAETOPHTHALMUS GROUP OF SPECIES

Culicoides majorinus Chu

(Figs. 15a-o)

Culicoides majorinus Chu, 1977: 99

Female : Tibet; fig. wing, antenna, palpus, eye separation, spermathecae, scutellum). - Hirth et al., 1985 (in press - India-records, description of both sexes).

Fig. 15. Culicoides majorinus Chu; a-o :

Female - a, frontovertex; b, antenna;
c, X and XI antennomeres;
d, maxillary palp; e, mandible;
f-h, legs; i, hind tibial comb;
j, mid leg claw; k, wing;
l, spermatheche.

Male - m, genitalia (aedeagus and
parameres removed); n, parameres;
o, aedeagus.

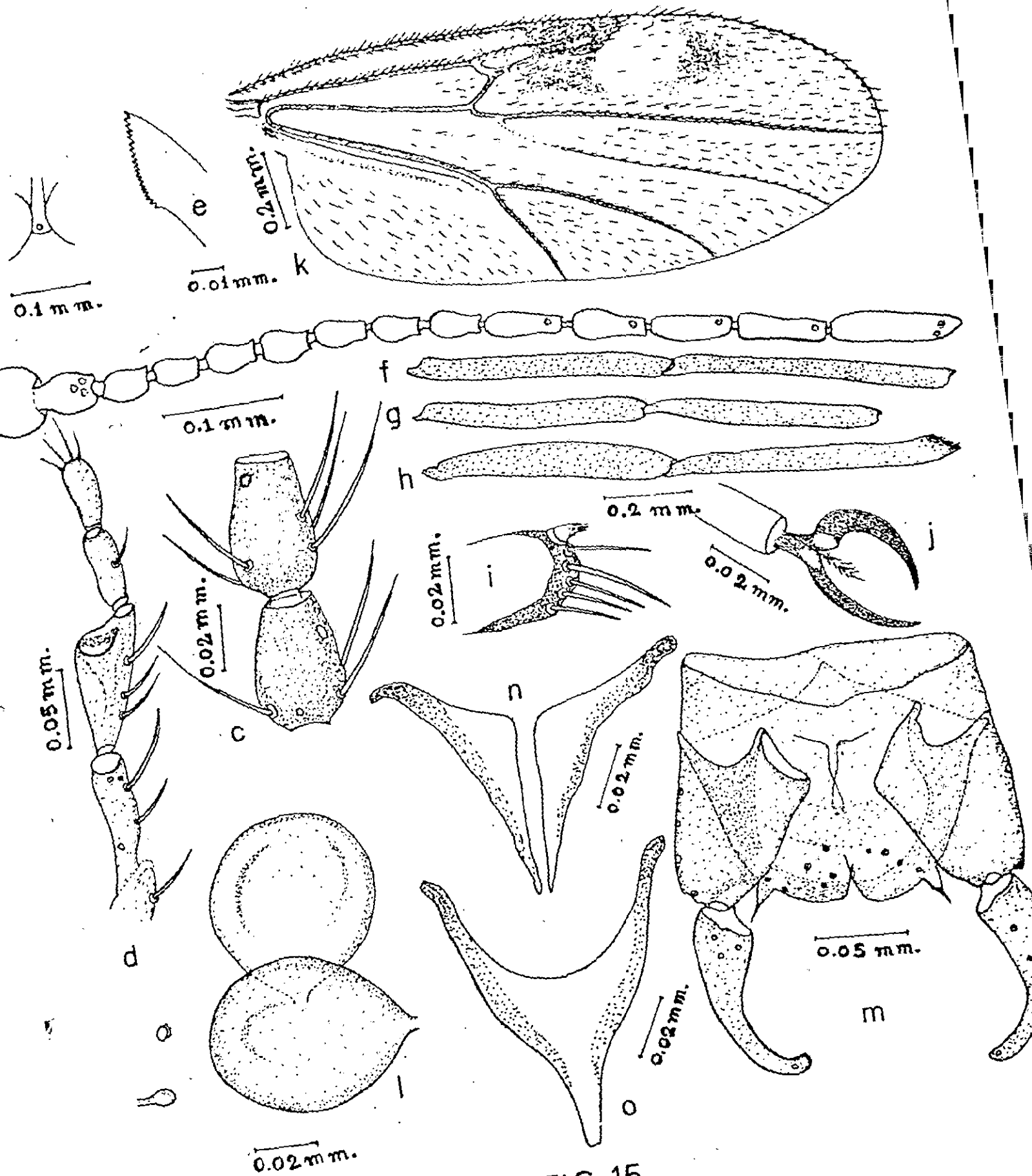


FIG-15

Female : wing length 1.62 mm; breadth 0.77 mm. Fronto-vertex (fig.15a) deep brown with scattered setae; eyes moderately separated, hairy. Antenna (fig.15b,c) brown; lengths of flagellar segments in proportion of 36-32-36-33-30-38-30-38-60-54-60-66-82; antennal ratio 1.10; sensilla coeloconica present on segments 3, 11-15. Palpal segments (fig.15d) with lengths in proportion of 15-47-42-19-21; 3rd segment moderately swollen distad, with large, shallow, round sensory pit; palpal ratio 2.55. Proboscis long, P/H Ratio 0.95; mandible (fig.15e) with 20 teeth.

Thorax : Dark brown, mesonotus unicolorous, with stout setose hairs. Legs (fig. 15f-h) brown, without pale markings; tibial comb (fig. 15i) with 5 spines, 2nd from apex longest, spur tip frayed; 4th tarsomeres not cordiform; hind tarsal ratio 2.03; tarsal claws and empodium of mid leg as in fig. 15j. Wing (fig. 15 k) with pattern as figured; deeply infuscated, especially along veins; dark brown stigma formed by deep infuscation of 2nd radial cell and just caudad in cell r_5 ; a second darker area on anterior margin of wing at midlength of cell r_5 , these 2 areas enclosing a rounded pale area between. Macrotrichia relatively sparse but strong and setiform, extending deeply into cell m_2 and to base of anal cell; costal ratio 0.64; Halter infuscated.

Abdomen brown. Spermathecae (fig.15 l) 2, oval with short slender necks; subequal, each measuring 0.049 ± 0.037 mm; rudimentary 3rd spermatheca and sclerotized ring present.

Male : similar to female with usual sexual differences. Wing length 1.25 mm; breadth 0.54 mm. Genitalia (fig. 15 m-o) : Ninth sternum with deep caudomedian excavation, ventral membrane bare; 9th tergum rounded distally with distinct caudomedian notch and short, slender apicolateral processes. Basistyle stout with short, slender dorsal and ventral roots; dististyle gradually narrowed and curved to slender rounded tip. Aedeagus (fig. 15 o) with slender basal arms, rounded basal arch extending nearly to $\frac{1}{2}$ of total length, tapering distad to slender, simple tip. Parameres (fig. 15n) similar to those of C. spinulosus.

Distribution : India, Sabah, Tibet.

Specimens examined : INDIA (West Bengal, Darjeeling township, Government College Campus, 2000 m elev., iii-ix.1968, S. K. Dasgupta, light trap, 7 males; 12 females); SABAH (Mt. Kinabalu, Kambaranga, 2840 m, I.xi.1958, L. W. Quate and T. C. Maq, 1 female, light trap (in Bishop Museum).

Comments : This species is structurally very similar to C. spinulosus but can be readily distinguished by its characteristic wing pattern. It is the only species in this group with such a wing marking. The female claws of C. majoriana are more asymmetrical than in spinulosus or any other species of the group.

The widely disjunct distribution of C. majorinus is noteworthy but not unexpected. A number of species or species groups of insects characteristic of higher elevations in central Asia have also been found on the high peaks of southeast Asia.

Gulicoides spinulosus Chu
(Figs.16a-c)

Gulicoides spinulosus Chu, 1977: 160 (female; Tibet; fig. wing, antenna, palpus, eye separation, pharyngeal armature, scutellum, spermathecae).--
Wirth et al., 1985 (in press - India records, description of both sex).

Female : Wing length 1.59 mm; breadth 0.74 mm. Fronto-vertex (fig.16a) light brown with scattered setae; eyes moderately separated, hairy. Antenna (fig. 16b,c) dark brown; lengths of flagellar segments in proportion of 40-34-36-36-36-36-³⁶38-54-52-54-82; antennal ratio 1.04; sensilla coelocenica present on 3, 11-15. Palpal segments (fig.16d) with lengths in proportion of 15-46-45-22-18; 3rd segment progressively enlarged from base to tip, with large, shallow, round sensory pit; palpal ratio: 3.2. Proboscis long, P/H Ratio 0.95; mandible (fig. 16e) with 20 teeth.

Thorax dark brown, mesonotum unicolorous, without pattern. Legs (fig. 16f-h) dark brown, without pale markings; hind tibial comb (fig.16i) with 5 spines, 2nd from spur longest, tip of spur frayed; 4th tarsomeres not cordiform; hind tarsal ratio 1.89.

Fig. 16. Gulicoides granulatus Chu; a-o :

Female - a, frontovertex; b, antenna;
c, X and XI antennomeres;
d, maxillary palp; e, mandible;
f-h, legs; i, hind tibial comb;
j, mid leg claw; k, wings;
l, spermathecae.

Male - m, genitalia (aedeagus and
parameres removed); n, parameres;
o, aedeagus.

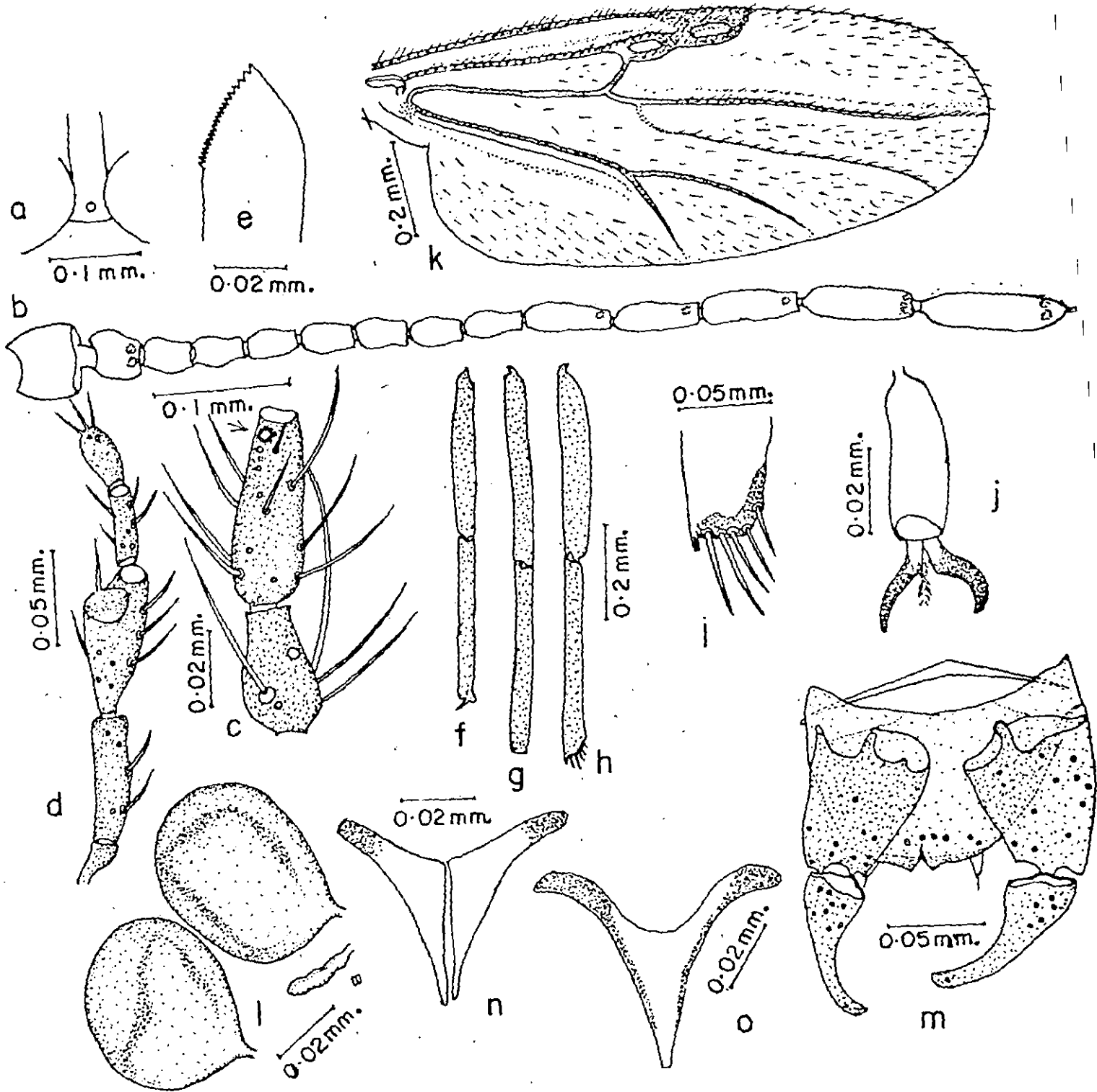


FIG-16

Tarsal claws subequal, outer claw slightly stouter and more curved than inner on mid leg; empodium prominent (fig. 16j). Wing (fig. 16k) unicolorous grayish, with dark stigma over 2nd radial cell forced by deep infuscation at extreme end of costal cell along with dark R_{2+3} and R_{4+5} veins and r-m crossvein; a small dark spot at wing base near basal arculus. Macrotrichia sparse but covering most of wing surface except lines adjacent to veins, those near anterior margin in cell R_5 coarser and stout; costal ratio 0.62. Halter knob pale.

Abdomen brown. Spermathecae (fig. 16l) oval with small slender neck; well sclerotized; subequal, each measuring 0.053×0.043 mm; rudimentary 3rd spermatheca and sclerotized ring present.

Male : Similar to female with usual sexual differences. Wing length 1.60 mm, breadth 0.66 mm. Genitalia (figs. 16 m-o): Ninth sternum narrow with shallow caudomedian excavation, ventral membrane bare; 9th tergum rounded caudad, with small caudomedian notch and pair of slender apicolateral processes. Basistyle stout, dorsal and ventral roots short and slender; dististyle narrowed on distal $\frac{1}{2}$ with slightly hooked tip. Aedeagus with moderately stout, divergent basal arms; basal arch extending to $\frac{1}{3}$ of total length; distal process evenly tapering to simple slender tip. Parameres separate, each swollen and angulate in midportion, with nearly straight, slightly tapering, anterolateral arm; tapering distally to straight slender tip; distal portions of parameres closely approximated.

Distribution : India, Tibet.

Specimens examined : INDIA (West Bengal, Darjeeling township, Government College Campus, 2000 m elev., iii-ix.1968, S.K. Dasgupta, light trap, 19 males, 26 females).

Comments : The Indian specimens closely match the figures given by Chu except that the area of spinules that he figured on the pharynx could not be found in our specimens; all that were visible in our material were some fine, longitudinal grooves in the corresponding area.

B) HELIOPHILUS GROUP OF SPECIES

Culicoides sheshi Majumdar and Dasgupta, n. sp.,

1972 : 128

(Figs. 17a)

Female : deep brown frontovortex with about 35 setae. Scutum also deep brown, unicolourous and without a pattern. Legs uniformly dark, without paleness; HFC of 5, first longest. Wing milky white, totally pale in slide-mount excepting a darkish stigma over second radial cell; macrotrichia sparse but in fair number in almost all cell surfaces, those on costa, radius and its branches very strong, blackish. Spermathecae two developed, unequal though spherical, intensely sclerotized with very short, narrow necks; a third rudimentary and a ring visible.

Male : unknown.

Distribution : India (Darjeeling, West Bengal).

Specimens examined : Holotype female, in slide-mount, collected from Govt. College Campus, Darjeeling, during September 1968.

Comments : The present species is unusual amongst West Bengal Culicoides in having uncoloured, milky white wings. It seems to be very limited in distribution and occurrence. Though based on a single female and male still unknown, it is a distinct species in our area and the only one of the Heliophilus Group.

C) HEAVEL GROUP OF SPECIES

Culicoides amarginatus Majumdar and Dasgupta, n. sp.

1972 : 79.

(Figs. 17b-d)

Female : greyish brown frontovertex with about 20 setae. Sencilla cocloconica on III-XIV. Third palpomere enormously enlarged at middle, its both ends tapering and a deep, sac-like sensory pit present. Scutum dark brown with a vitta at middle, the vitta broad at hind margin and then as a linear band to apex. Legs dark brown with subbasal pale spots on tibiae and subapical pale bands on first four femora only; HTC of h_1 first, longest. Wing darkish brown with about 10 small, roundish pale spots;

macrotrichia fairly enough in almost all cell surfaces. Spermathecae two developed, subspherical and unequal, lightly sclerotized with very short, narrow necks; a third rudimentary and a ring present.

Male genitalia : typical of the subgenus, specialities being - aedeagal arms long, slender, divergent and joining small aedeagal body of conical outline that is drawn caudad into a very short, thick and round-tipped stem; parameres separated, long stem of each as a filamentous part ending to a bare, simple tip bent inwards and caudad.

Distribution : India (Habra and Chinsurah of West Bengal).

Specimens examined : 3 females, 2 males including types, collected during October 1966.

Comments : The separateness of the distalmost pale spot in wing cell R_5 alongwith peculiar aedeagus and long filamentous parameres of male genitalia make the present species a distinct one.

Culicoides basui Majumdar and Dasgupta, n. sp.

1972 : 93.

(Fig. 17c)

Female : deep brown frontovertex with 15 setae. Sensilla coeloconica on III-XIV. Third palponere very broad past middle, tapering apicad and with a fairly deep sensory pit. Scutum brownish with the median area from front to hind end darker and

characteristically flanked by linear pale streaks. Legs brown with femora and tibiae vaguely pale towards base and apical end respectively, a subbasal pale spot also on all tibiae; HTC of 4, first longest. Wing light brown with about 8 somewhat large clearly set pale spots, there being no pale spot in distal area of cell R_5 ; macrotrichia scanty, lacking in cell M_4 and anal cell besides the basal area of wing. Spermathecae two developed, subequal, suboval to subspherical, lightly sclerotized with short, narrow necks; a third rudimentary only visible.

Male : unknown.

Distribution : India (Gobardanga and Habra of West Bengal).

Specimens examined : 2 females, type specimens in slide-mounts, collected during March - May, 1967.

Comments : Absence of any pale spot in wing cell R_5 in the region distal to the post-stigmatic pale spot, is a very obvious distinctive feature of the present species. Its characteristic scutal pattern further confirms its distinction, though it is obviously limited in distribution and occurrence.

Culicoides bengalensis Majumdar and Dasgupta, n. sp.,

1972 : 97

(Figs. 17 n-p)

Female : frontovertex, antennal sensoria as in basui. Third palpomere longer than second, very broad at middle and with a deep, sac-like sensory pit subapical. Scutal colouration somewhat same as in basui. Legs brown, femora pale only at extreme base and a subbasal pale spot in hind tibia only; HTC of 4, second longest. Wing light brown with only two small and somewhat vague pale spots at r-m and at tip of vein R_{4+5} ; macrotrichia sparse but in fair number in almost all cell surfaces. Spermathecae two developed, subequal, oval to subpherical, moderately sclerotized with distinct necks; a third rudimentary only visible.

Male genitalia : Sternum IX with flat caudal margin; AP prominent; aedeagus with short, horn-like arms directed laterad but stem long with bulged caudal tip; parameres separated, basal arms bent laterad and each stem narrowed caudad to filamentous, straight, bare terminal part.

Distribution : India (Bankura, Gobardanga, Habra and Santiniketan of West Bengal).

Specimens examined : 7 females, 1 male including slide mounted types, collected from several places of West Bengal during 1967-1968.

Comments : The present species is of a wide occurrence and characterised by light brown wings with about 2 pale spots only. Its male genitalic features are also distinctive.

Guliceides drydeus Wirth and Hubert, 1972.

Female : darkish grey frontovortex with about 35 setae. Sensilla coeloconica on III, XI-XIV, rarely on XV. Third palponere enlarged subapical with a small, moderately deep sensory pit. Scutum bright brown stippled by deep brown spots at seta-bases forming a median vitta with others forming irregular line marks. Legs brown with subapical pale spots on femora, also showing some basal paleness, and subbasal pale spots on all tibiae; HTC of 4, first longest. Wing darkish brown with 4-5 small pale spots - cell M_1 , M_2 and M_4 without a pale spot; macrotrichia copious, almost in the whole of wing surface. Spermathecae two developed, subequal and subspherical, intensely sclerotized with prominent, narrow necks; a third rudimentary and a ring visible.

Male genitalia : Sternus IX with a fairly deep caudomedian excavation, ventral membrane from it spiculate; tergum IX very broad, with a pair of long, divergent AP, aedeagus with short, divergent, horn-like arms and stem abruptly short, thick and with caudal margin slightly concave; parameres separated, each with a basal arm sharply bent laterad, the stem gradually tapered to filamentous, bare tip.

Distribution : India (Chinsura, Gobardanga and Itachuna of West Bengal), Malaya, Sarawak, Sumatra and Thailand.

Specimens examined : 8 females, 1 male - all collected from several parts of West Bengal during 1966-1967.

Comments - The present species is an easily distinguished species of West Bengal though it seems to be also limited in distribution and occurrence.

Culicoides fortinalis Majumdar and Dasgupta, n. sp.,

1972 : 120

(Figs. 17 f-h)

Female : dark brown frontovertex with about 25 setae. Sensilla coeloconica distributed as in basui. Third palpomere long and also enormously enlarged past middle with a deep, sac-like sensory pit. Scutum deep brown, broadly pale at caudoscuteal area, the paleness extending to front margin as a medial streak. Legs light brown; HTC of 4, first longest. Wing brown with only 2 small, roundish pale spots - poststigmatic pale spot and that at r-m; macrotrichia copious. Spermathecae two developed, as in drydaeus, but a third rudimentary and a ring not visible.

Male genitalia : patterned as in bengalensis differences being sternum IX concave in its caudal margin, the AP. divergent, dististyle shorter and ends in an acuminate tip from a thicker base and parameres each with caudal end somewhat thicker.

Distribution : India (Siliguri, West Bengal).

Specimens examined : 5 females, 1 male including types, collected from Siliguri during May-June 1968.

Comments : The present species, found limited in the sub-himalayan plains in the northern part of West Bengal resembles C. bengalensis of the southern part of West Bengal. The two are distinct in scutal colouration, in hairiness of wings and in details of male genitalia.

Culicoides inornatus Majumdar and Dasgupta, n. sp.

1972 : 140.

(Fig. 17c)

Female : Antenna brownish with sensilla coeloconica on III-IV. Third palpomere progressively enlarged apically with a very shallow sensory pit. Scutum yellowish brown without any conspicuous pattern. Legs also yellowish brown, unicolourous without any colour banding; HTC of 4, second longest. Wing pale grey without any pale spot, only a very narrow pale streak apparent extending from wing base to middle of cell M_2 and vein M_1 vaguely straddled in distal half by a pale streak; macrotrichia abundant. Haltere knob infuscated. Spermathecae two developed, sub-spherical unequal and moderately sclerotized; a third rudimentary apparent but no ring.

Male : unknown.

Distribution : India (Siliguri, West Bengal).

Specimen examined : Holotype female in slide mounted, collected from Siliguri in May 1968.

Comments : The present species is a typical of the subgenus Oocacta in several respects. It seems to be very limited both in its distribution range and occurrence.

Culicoides rateli Majumdar and Dasgupta, n. sp.,

1972 : 169

(Fig. 17 1)

Female : frontovertex darkish grey with numerous setae, Sensilla coeloconica on III-XV. Third palpomere enlarged at middle, tapering distad with a broad, shallow sensory pit. Scutum dark brown, colour pattern not apparent. Legs dark brown, pale basad in all femora, and with a narrow subbasal pale band in all tibiae; HTC of 4, second longest. Wing pale greyish with 4 pale spots - that at r-m and at poststigmatic level quite distinct while that at cell M_4 and anal cell vague. Spermathecae two developed, subequal, suboval, moderately sclerotized with very short, narrow necks; a third rudimentary present but a ring not visible.

Male : unknown.

Distribution : India (Darjeeling, West Bengal).

Specimen examined : Holotype female in slide-mount, collected from Darjeeling in June 1968.

Comments: The present species recalls G. kibunensis Tokunaga and G. chinavensis Arnaud. It is also very limited in distribution and occurrence.

Gulicoides pharui Majumdar and Dasgupta, n. sp.,

1972 : 197.

(Figs. 17 j-1)

Female : Frontoververtex darkish brown with about 25 setae. Sensilla coeloconical on III - XIV, occasionally missing from XII. Third palpomere enormously enlarged, subapical with a large, deep sensory pit and thin tapering to apex. Scutum brown, colour pattern not apparent. Legs brown, colour pattern as in pateli; H.T.C. of 4, first longest. Wing light brown with about 9-10 small pale spots and pale streak along branches of medial vein, macrotrichia abundant. Spermathecae two developed, cub-spherical, slightly unequal, highly sclerotized with short narrow necks, a third rudimentary and a ring visible.

Male genitalia : pattern as in fortinalis with peculiarities as - aedeagus stem flaring at tip but flat-margined and paramere each with caudal end blunt tipped.

Distribution : India (Darjeeling, West Bengal).

Specimens examined : 15 females, 2 males, all collected from Darjeeling in June, 1968.

Comment : The present species is common in occurrence though limited in distribution. The pale spots in its wing are peculiar, not found in other species of Gulicoides in West Bengal.

Gulicoides shortinapis Majumdar and Dasgupta, n. sp.

1972 : 201.

(Figs. 17 n)

Female : Frontovortex blackish brown with about 30 setae. Sencilla ecloconica on III, XI - XV. Third palpomere slightly enlarged at middle with a shallow sensory pit, tapered apical. Scutum yellowish brown, pattern not apparent. Legs as in pateli; H.T.C. of 4, first longest. Wing light brown with about nine small pale spots and paleness at wing base, macrotrichia sparse specially in cell M_2 , M_4 and anal cell. Spermathecae two developed, unequal to subequal, subspherical to spherical, strongly sclerotized; a third rudimentary and a prominent wing visible.

Male : Unknown.

Distribution : India (Darjeeling, West Bengal).

Specimens examined : 2 type females, in slide-mounts, collected from Darjeeling, June, 1968.

Comment : The present species resemble pharagal very closely but it differ in having only one pale spot in cell M_1 and its third palpomere shorter than the second.

Fig. 17. Culicoides ghoshi Majumdar and Dasgupta, n. sp.:

a, female wing.

Culicoides smarzinatus; b-d :

b, female wing; c, male aedeagus;

d, male paramere.

Culicoides basui Majumdar and Dasgupta, n. sp.:

e, female wing.

Culicoides fortivalis Majumdar and Dasgupta, n. sp.:

f-h: f, female wing; g, male aedeagus;

h, male paramere.

Culicoides pateli Majumdar and Dasgupta, n. sp.:

i, female wing.

Culicoides sharnai Majumdar and Dasgupta, n. sp.:

j-l: j, female wing; k, male aedeagus;

l, male paramere.

Culicoides shortivalis Majumdar and Dasgupta, n. sp.:

m, female wing.

Culicoides bengalensis Majumdar and Dasgupta, n. sp.:

n-p: n, female wing; o, male aedeagus; p, male paramere.

Culicoides inornatus Majumdar and Dasgupta, n. sp.:

q, female wing.

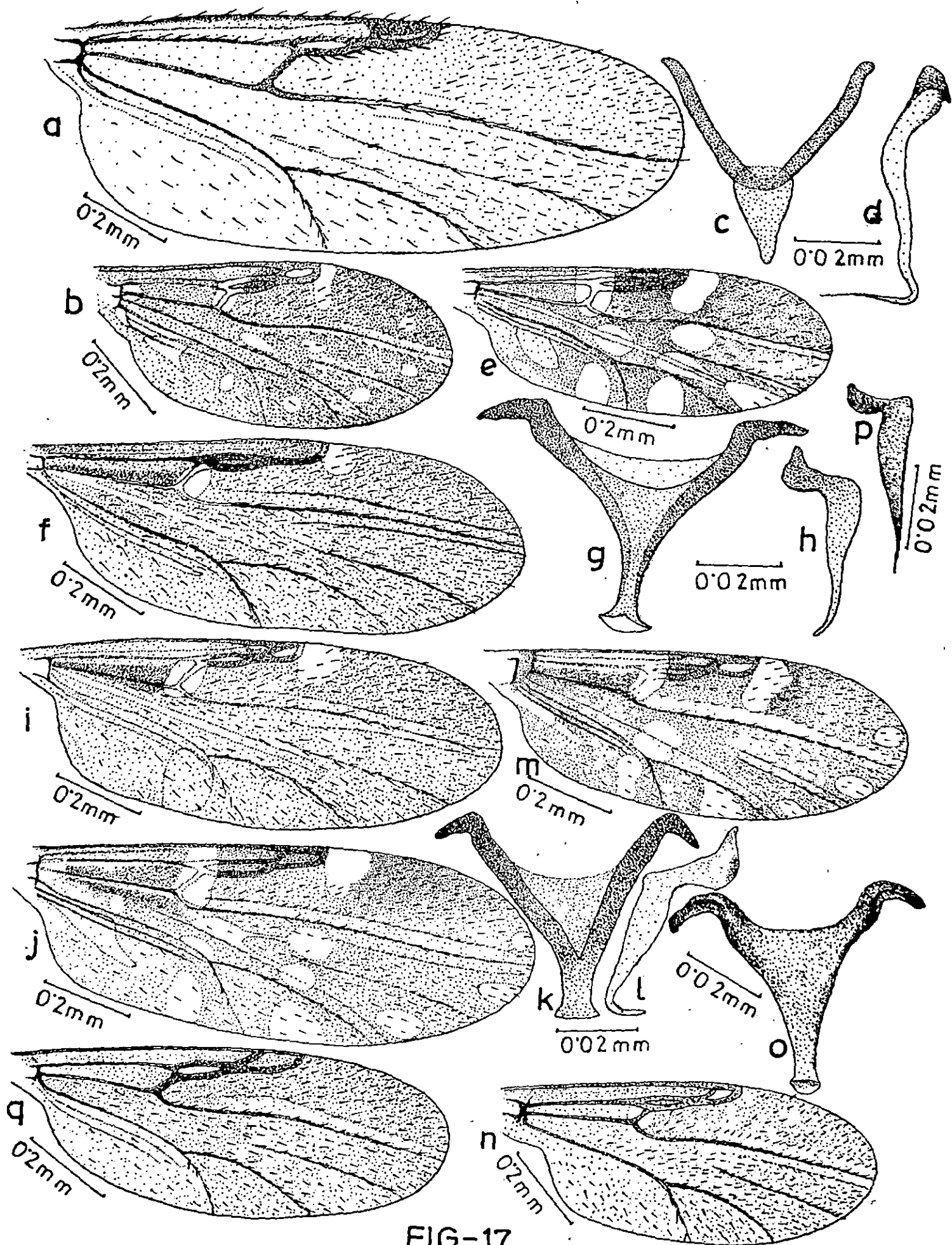


FIG-17

Culicoides submarginatus, n. sp.

(Figs. 18 a-d)

Female : Unknown.

Male : Wing length 1.23 (1.2 - 1.26, n = 6) mm, breadth 0.48 (0.46 - 0.5, n = 6) mm.

Wing (fig.18a) : Grayish brown with extensive pale areas as figured; about 18-20 pale spots, generally small but distinct and distal pale spots narrowly separated from wing margin; anterior area of cell R_5 and radial cells darker; a pale area engulfing basal areolus and bases of all trunk veins present at wing base; pale spot touching r-m with a dark spot extended narrowly to costal margin and posteriorly medio-cubital stem; cell R_5 with a post-stigmatic and a subapical large pale spot, another large spot at apex nearly touching the anterior wing margin; cell M_1 with a transversely elongate pale area at base touching vein M_1 and extended anteriorly to costal margin, one subapical oval and a large, semi-elliptical spot at distal portion; cell M_2 with three distinct pale spots; cell M_4 with a rounded, large and a small, elongate spots; anal cell with four pale markings; macrotrichia scanty; costa extends to 0.51 (0.49 - 0.53, n = 6) of wing length. Halteres pale throughout.

Genitalia : (figs.b-d): Sternum ix with a broad, moderately deep caudomedian excavation, ventral membrane epiculate; tergum ix tapered distad with a pair of slender, long, highly divergent A.P.;

Fig. 18. Culicoides submarginatus, n.sp.; a-d :

Male - a, wing; b, genitalia (aedeagus
and parameres removed), c, aedeagus;
d, parameres.

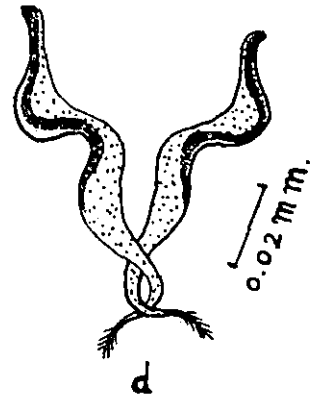
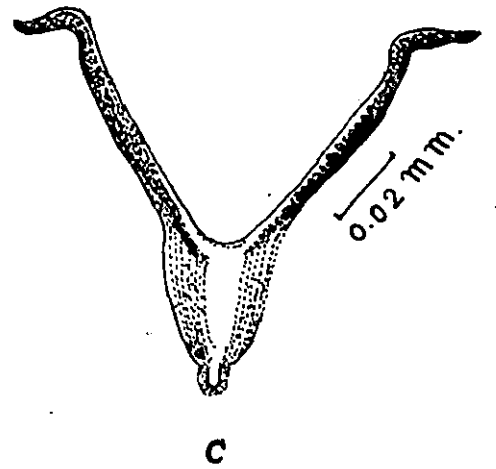
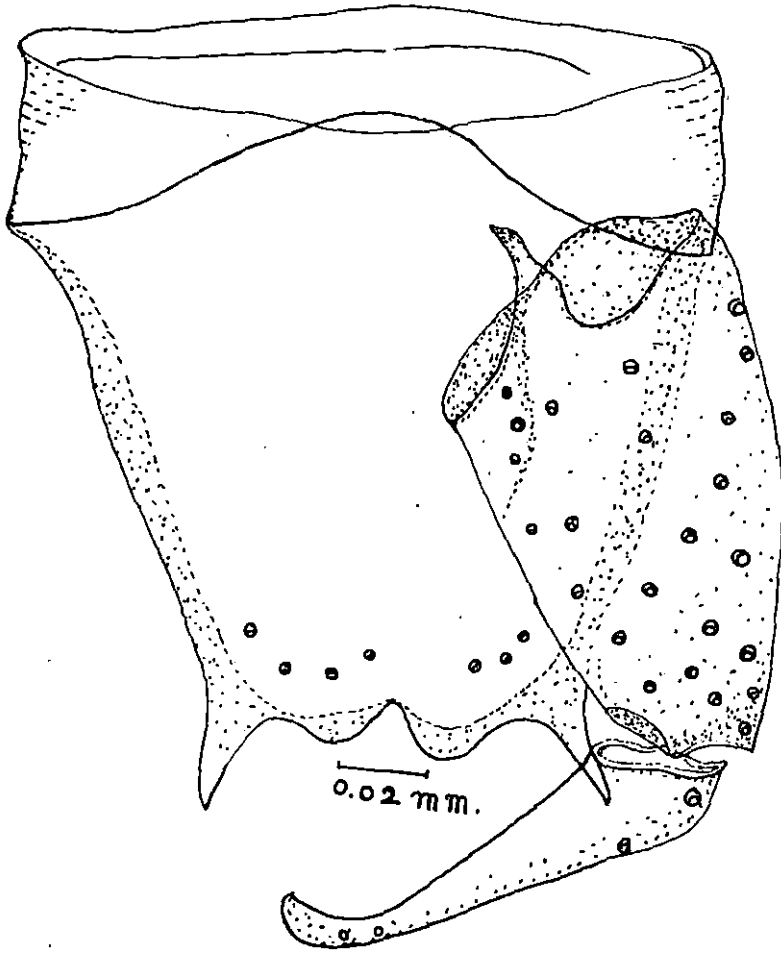
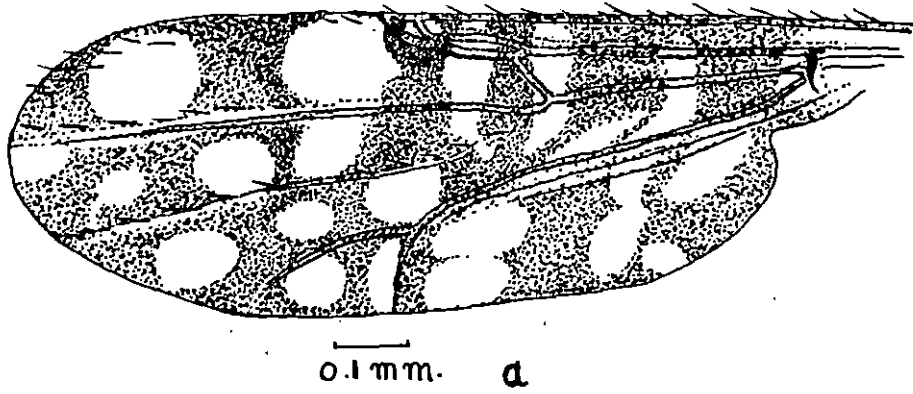


FIG-18

the caudal margin between them with a deep median notch. Basistyle broad, usually shows a flexure mark of varying size at base; ventral root simple, dorsal root absent. Dististyle broadest at base, slender, progressively tapered to middle with apical portion slightly enlarged. Aedeagus (fig. 18c) with slender long, almost straight, strongly sclerotized divergent arms with bent and basal arch deep, extending to more than half of aedeagal length; the distal stem moderately long, broad, gradually narrows to form knob-like blunt sclerotized tip. Parameres (fig. 18d) separated, each with angled or twisted basal arm and the stem gradually narrowed to filiform, spinose tip.

Distribution : India (Darjeeling, West Bengal State).

Type-data : Holotype male (Type No. Ent Cs 2 PCZH), West Bengal, 1968, Dr. S. K. Dasgupta and author, light trap, paratypes: 5 males collected as follows: West Bengal-Darjeeling: 3 males; Palbazar: 2 males at light trap.

Comments : This species is distinct from other members of the Neavei Group, such as, annarginatus Majumdar and Dasgupta, n.sp. 1972, bengalensis Majumdar and Dasgupta, n.sp. 1972, fortinelsis Majumdar and Dasgupta, n.sp. 1972, nateli Majumdar and Dasgupta, n.sp. 1972, shargali Majumdar and Dasgupta, n.sp. 1972, shortinelsis Majumdar and Dasgupta, n.sp. 1972 and basui Majumdar and Dasgupta, n.sp. 1972 by having many pale spots in wing, reduced number of macrotrichia in the wing, the shape of basal arms of aedeagus and

ornamentation of its distal tip, sternum with deep caudomedian excavation, basistyle with simple ventral root and parameres with fine subapical fringing hairs) *spinose lips*:

The distal pale spots of wing which are nearly touching the wing margin are the characteristics of the species and hence the name submarginatus.

C) SCHEULTZEE GROUP OF SPECIES

Culicoides oxyzona Kieffer, 1910:193.

Culicoides kiefferi Patton, 1913: 336.- Kieffer,

1921b: 7 (as C. nattoni nom. nov.).- Patel, 1921:272

Culicoides alatus Dasgupta and Ghosh, 1956c: 162.-

Sen and Dasgupta, 1959b: 617.

Female : blackish grey of small to medium size. Eyes broadly separated, bare. Sensilla coeloconica on III, VIII-X (occasionally also on VII, rarely on V and XI). Third palpomere slightly enlarged distal with a well-formed sensory pit. Scutum spotted showing dark stripes on olive-grey surface, the stripes being assemblage of scores of small, brown punctures each of which encircles a seta base; scutellum pale, postscutellum relatively darker. Legs brown with blackish knee spots and femora pale basad excepting the hinder pair which occasionally appear almost totally infuscated while tibiae show pale marks at both ends; HFC of 4, first longest. Wing copiously blotched with about 15 pale spots on a

grey background as - at wing base, at r-m, in cell R₅ (usually 4 spots but may vary due to differing states of the pale spots), 2 in cell M₁, at base of vein M₂, in each of cells M₂ and M₄, and 2 in anal cell with basal one very extensive; pale spots occur as well on vein M₁ for variable extent, at tip of vein M₂ and cubital branches, and above cubital fork; radial vein just thickens beyond r-m and though obscured distad in fresh forms by a dark stigmatic spot, the same is seen in suitable preparations to meet costal margin of wing at a sharp angle in unbranched state with the result that all traces of first radial cell are absent and the second represented only by its steep distal closure; wing trichiation includes macrotrichia mostly on and around wing veins. Haltere blackish in its stem and basal one-third of the knob while the rest pale (dull white or creamy in fresh state). Spermathecae two developed, intense to lightly sclerotized, unequal pyriform and with prominent, narrow necks; a third rudimentary (occasionally fully developed) and a ring visible.

Male genitalia : ninth abdominal sternite with a wide caudo-median excavation and spiculate ventral membrane while the corresponding tergite shows no inundation in its posterior margin having finger-like apicolateral processes curved outwards; ventral roots prominent, clubbed while dorsal root slightly longer, pointed; dististyle straight save for incurved, acuminate tip;

aedeagus with stout basal arms outcurved near tip and stem saddle shaped; parameres two, separated and each shows a stout basal knob and slender stem tapering towards the end having several fine, fringing hairs with its distalmost flexure directed ventrad and mesad although it is almost straight at middle.

Distribution : very extensively distributed in many Asiatic countries and in India found distributed in and around Calcutta including remote suburbs Bolpur, Jhargram, Kurseon, Darjooling of West Bengal; Golaghat, Gauhati and Burnihat of Assam; Poona of Maharashtra; Barkuda Is. of Orissa; Waltair of Andhra Pradesh and Madras and Vellore of Tamilnadu State.

Specimens examined : 25 females, 20 males, collected from several parts of West Bengal during 1960-1968.

Comments : The present species alongwith C. kingi Austen, C. neoprotaniscia Patton, C. punctigerus Tokunaga and C. housei Caucey has long been referred in literature as synonyms of C. schultzei (Enderlein), described from Africa. It is an extremely variable species and is the most dominant form of Gullicoides in almost all its place of occurrence. Firth (1981-1982, Priv. Comm.) finally contends that all Asian forms of the populations in oxystoma - schultzei complex should henceforth be referred as belonging to C. oxystoma Kieffer, since the

Ethiopian species, G. schultzei is different in many a subtle aspects.

The Indian records of G. oxystoma is due to a number of workers (Mukerji 1931a, Annandale 1913, Christophers et al., 1925, Smith 1929, Edwards 1952, Rouben 1965, Dasgupta and his collaborators 1956-1972), while for records in other Asiatic countries, a reference is to be made to Tokunaga (1937), Chang (1951), Arnaud (1956), Suckley (1938) etc.

KEY TO WEST BENGAL SPECIES OF SUBGENUS OEGACETA

1. Wings unmarked or poorly marked. Tarsi with ventral spinules rather well developed and claws asymmetrical, prominent in midlegs 2 (Chaetophthalmus Group)
- .. Wings usually well marked. Tarsi without any prominent ventral spinules and claws never asymmetrical 3 (Heliophilus, Neavei and Schultzei Groups)
2. Wing with a small shaded area covering costal confluence with second radial cell, otherwise pale G. spinulosus
- .. Wing with shaded patch in two areas at least - one at second radial cell level, very extensive, and the other smaller, half way in cell R_5 from second radial cell G. majoratus

-
3. Wing with 0-2 small pale spots, otherwise shaded 4
- . Wing with small pale spots 5 or more 7
4. Wing with a dark stigmatic mark overlying second radial cell C. ghochi
- . Wing with no stigmatic mark as above 5
5. Wing without any apparent pale spot C. inornelatus
- . Wing with 2 small, distinct pale spots - at r-m and at post-stigmatic level 6
6. Caudoscutal area pale and paleness drawn to front margin of scutum as a narrow pale streak medially C. fortipalpis
- . Caudoscutal area dark and the shade broadly drawn to front margin of scutum, the whole flanked by narrow, linear pale streak 7
7. Wing with no paleness or pale spot in distal half of cell R_5 C. bengalensis
- . Wing with a small, distinct pale spot near apex in cell R_5 8

8. Wing with cell M_1 and M_2 each provided at least with one pale spot C. *haculi*
8. Wing with cell M_1 and M_2 devoid of any pale spot 9
9. Presence of a prominent, marginal pale spot in wing cell M_4 C. *pateli*
9. Wing cell M_4 totally shaded, without a pale spot C. *drydoeus*
10. Wing cell R_5 with one characteristic bilobed pale spot in apex; radial vein unbranched or incompletely branched terminally, without a developed radial cell C. *oxystoma*
10. Wing cell R_5 with a small, roundish apical pale spot, never bilobed; radial vein branched terminally and two well developed radial cells 11
11. Wing cell M_1 and M_2 each with 3 pale spots and total pale spots in wing surface at least 15 pale spots C. *submarginatus*

- . Pale spots in wing cell M_1 and M_2 , and in wing surface otherwise, lesser than as above 12
12. Distal most pale spot in wing cell M_2 and M_1 , not touching wing margin C. emarginatus
- . Distal most pale spot in wing cell M_2 and M_1 , touching wing margin broadly .. 13
13. Wing cell M_1 with 1 pale spot C. abortivipennis
- . Wing cell M_1 with 2 pale spots C. sharaei

Subgenus Trithecoides Wirth and Hubert,
1959, 1 : 2.

(Type of the subgenus : Culicoides flaviscutatus Wirth and Hubert, by original designation)

General characters : small to medium sized, with scutum and upper pleura usually pale yellow and other thoracic areas brown to dark brown. Wing with second radial cell usually large, its apical half or so in a pale spot; other pale markings in the lightly shaded wing are one at r-m, variable number of pale spots/streaks in cell R_5 to anal cell and wing apex often narrowly pale; macrotrichia scanty, hardly extends further down beyond cell R_5 .

Eyes contiguous or touching, bare. Distal sensilla coelocornica confined to antennomeres III, XI - XV; sensory hairs in third palpal segment as a rule not restricted to a sensory pit which, if formed, is either ill-formed or shallow and superficial. Hind tibial comb of 4 spines (5 or 6 in stray cases) in apical row, the second (sometimes, the first) from spur longest. Three well-developed spermathecae, of moderate to high sclerotization, equal to unequal - often the central one large and the other two palpably smaller, spherical or pyriform in shape with narrow openings to spermathecal ducts or broader than long with wider openings to spermathecal ducts which are mostly unsclerotized at beginning. In male genitalia, apicolateral processes always present, basistyllic ventral root greatly reduced, aedeagus stout and conical with variably prominent arms and blunt-tipped, bare stem while parameres each tapering caudad to a simple, slender and usually non-spinose tip.

The 20 species of Culicoides belonging to subgenus Trithecoides are found to occur in the State of West Bengal and these may be placed under 4 known groups of species within the subgenus. The important characters of these 4 groups are as follows :

Anopheles Group : mandibular teeth 8-15, strongly incurved with basal few thicker; scattered sensory hairs apical in third palpal segment lacking in any sensory pit; scutum somewhat infuscated; 4 spines in the apical row of hind tibial comb,

second from apex longest; three spermathecae equal to each other or nearly so, subspherical to slightly pyriform and their necks narrow, sclerotized at beginning for a short distance; in male genitalia, dististyle progressively tapering apicad and gently incurved, submedian lobes in the caudal margin of tergum IX prominent, aedeagal stem slender and prominent with finely rounded, bare tip while parameres are as two slender sclerites tapering to bare, simple and pointed caudal tip.

Flavescens Group : mandibular teeth 14-21, small, conical with apical one showingly thick; scattered sensory hairs apicad in third palpal segment lacking in any sensory pit or having such a pit subapicad containing these hairs; scutal colouration simple yellowish to brown yellow; 4-6 spines in the apical row of hind tibial comb, first or second from apex longest; three subequal spermathecae, subspherical to slightly pyriform with slender, sclerotized necks; in male genitalia, dististyle tapering and incurved at distal third, submedian lobes in the caudal margin of tergum IX palpable though not prominent, aedeagal stem somewhat long, slender and terminates in a finely rounded tip while parameres each with stem swollen at base but tapering caudad to a fine slender, bare, pointed tip curved laterocephalad.

Macfiei Group : mandibular teeth 6-7, incurved with those at any end thicker; scattered sensory hairs apicad in third palpal segment lacking in any sensory pit; scutal colouration variable -

simple, shining yellow to brown; 4 spines in the apical row of hind tibial comb, second from spur longest; three unequal spermathecae, the central one larger and the other two smaller, subequal but all as broad as or slightly broader than long with their necks also broad though unsclerotized at beginning; in male genitalia, dististyle progressively tapering apicad and incurved at middle or beyond, submedian lobes in the caudal margin of tergum IX prominent, aedeagal stem short, slender with thickly blunt, bare tip while parameres each with thick base sharply tapers caudad to a very slender, short, pointed process bare and directed laterad.

Paripalpal Group : mandibular teeth 9-16 small and conical, usually subequal or with basal few thicker and directed outward; scattered sensory hairs apicad in third palpal segment sometimes located in an ill-formed sensory pit and the segment swollen for most part; scutal colouration variable - yellowish or brownish with stray vittae in some cases; 4 spines in the apical row of hind tibial comb, second from spur usually longest; three spermathecae unequal, the central one large and other two smaller subequal, and all slightly longer than broad with spermathecal necks broad but unsclerotized from beginning; in male genitalia, dististyle progressively slimming apicad with incurving flexure at distal fourth, submedian lobes in the caudal margin of tergum IX perceptible, aedeagal stem variable with slender or thick

caudal end simple and blunt or finely rounded while parameres each with prominently thick base sharply tapering to a short, filiform process directed outward and laterocephalad.

A) ANOPHELIIS GROUP OF SPECIES

Culisicoides anophelia Edwards, 1922, 161

Female : wing length 1.1 mm, breadth 0.5 mm.

Head : frontovertex dark brown. Eyes broadly touching, bare. Antenna with average lengths of segments III-XV in proportion of 14-9-9-10-10-10-10-10-13-12-14-15-24; AR 0.96; distal sensilla coeloconica on III, XIII - XV and segment XV ending in a well-shaped nipple-like process. Maxillary palp with average lengths of segments I - V in proportion of 3-10-12-15-7; segment III swollen with sensory hairs scattered in its distal half; L/W ratio 1.7. Maxillary blade with about 18 (n = 10) teeth in one and a half row with apical ones thick and well-sclerotized. Mandible bears 15 (14 + 16, n = 10) teeth, strongly incurved and decreasing in size towards apex.

Thorax - blackish patches at both ends of the dorsal aspect of yellowish brown scutum while scutellum, postscutellum and pleural area near coxal ends of legs are dark brown; 3 stout bristles on scutellum. Legs pale brown and usually with subbasal and subapical pale bands on femora and tibiae; HTC of 4, second from spur longest; tarsal ratio of hind leg 2,2; tarsal claws bifid at tip in all legs.

Wing - brownish with rather indistinctly marked pale areas as : at base - very extensive and continued to wing margin in cell M_2 and anal cell, at r-m, 2 pale spots in cell R_5 - the basal most one extending to second radial cell and the other one extended down to vein M_2 , one each in cell M_1 , M_4 and anal cell; a pale streak along wing apex is also apparent; macrotrichia scanty; costa extends to 0.7 of wing length. Halteres dirty yellow in fresh state and may appear somewhat infuscated in preserved/mounted forms.

Abdomen - dark brown. Spermathecae three, subspherical to slightly pyriform, almost equal to each other in size and measures on an average 0.043×0.044 mm.; necks not broad but sclerotized and a ring distinctly visible.

Male : similar to female with usual sexual differences excepting that the tarsal claws are similarly bifid at tip in both the sexes. Wing measures 0.9×0.5 mm.

Genitalia - sternum IX with a feebly perceptible caudomedial depression; tergum IX with a shallow caudomedial notch flanked by large apicolateral processes directed backward, the lobe between an apicolateral process and the notch prominent and subconical. Basityle with short, stumpy ventral root and slender dorsal root; dististyle incurved and copiously slendered at distal third, tapering to a point. Aedeagus stout with arms and stem quite

prominent, the stem finely rounded at caudal tip. Parameres separated, each flexed at base more than once and tapering distally to a very slender, laterally curved, simple point.

Distribution : Malaya, India, Sumatra; Burma, Hong Kong, Indochina, Sri Lanka, Taiwan and Thailand.

Specimens examined : INDIAN FORMS : 8 females, 2 males at light trap during January - March 1957, by S. K. Dasgupta, from environs of Calcutta; 55 females, 8 males at light and sticky trap or from mosquito hosts during October 1956 - April 1959, from Bagmati (near Calcutta), by S. K. Dasgupta; 25 females, 8 males from Coochbehar, Siliguri, Balurghat, Malda and Bolpur during 1971-1972 and 1978-1979 at light/sticky trap by S. K. Dasgupta and P. P. Choudhuri; also from Chinsura and Batanagar in 6 females at light trap by S. K. Dasgupta during 1977 and 1981. EXOTIC FORMS : 4 slide-mounts of females received from Dr. Wirth - 2 from Colombo, 1 from Kuala Lumpur and 1 from Thailand, all collected during 1 year period till June 1959 at light trap.

Comments : It closely resembles G. culiciphagus Wirth and Hubert and G. basinalis Wirth and Hubert which like it are parasites on female mosquitoes in adult stage. It is unique in having tarsal claws of female legs bifid, a feature which is usually seen in the males of Culicoides. The brown scutum with a splash of blackish shade at least at one end is its another distinctive feature.

Some variation in its leg and wing colouration follows from the descriptions offered by different workers on G. anophelis, but the equality in size of its three spermathecae, thicker teeth at base of mandible and abruptly slendered distal third of dististyle seem to be quite stable and these also help to sort it out in any collection of Trithecoid Calicoides easily. There are, however, instances of misidentification of this species which Wirth and Hubert (1959) corrects as due while reporting new distribution data. Other noteworthy workers recording the species in different countries are Macfie (1932, 1934), Mayer (1937), Causey (1938), Buckley (1938), Okada (1942), Arnaud (1956) etc.

The Indian records of G. anophelis to the date are in and around Calcutta (Gravelly, 1911; Dasgupta, 1961-1964; Sen and Dasgupta, 1958, 1959), Jalpaiguri (Iyengar in Edwards, 1922); Golaghat (Christophers et al., 1925, in Wirth and Hubert, 1959), Burnihat area (Smith, 1929), Gauhati (Smith and Swaminath, 1932), and Doom Dooma of Assam (in Wirth and Hubert, 1959), Jabbalpore of Madhya Pradesh (Smiton and Little, 1925) and Rajamundry of Andhra Pradesh (Fearnside, 1900). Additional localities reported now were Coochbehar, Siliguri, Balurghat and Malda town in the northern part of the West Bengal State and Bolpur, Chinsurah and Batanagar in the south.

Culicoides insolens, n. sp.

(Figs. 19a-k)

Female : wing length 1.3 mm, breadth 0.63 mm.

Head - frontovertex (fig. 19a) light brown with about 12-16 setae scattered all over. Eyes contiguous for a distance equalling the diameter of 3 facets together, bare. Antenna (fig. 19b) brown with average lengths of segments III-XV in proportion of 16-16-18-18-20-19-19-17-25-24-28-28-40, each antennomere being large and cylindrical; AR 1.00; sensilla coeloconica on segments III, VII, XI-XV. Maxillary palp (fig. 19c) with average lengths of segments I-V in proportion of 9-25-20-11-12; segment III shorter than II, stout and swollen past middle with a small sensory hair bearing pit; L/W ratio 2.22. Proboscis long, P/H ratio 1.77. Mandible (fig. 19d) with 8 subequal, stout teeth slightly incurved.

Thorax - yellowish brown; scutum yellow, scutellum brown with 16 larger and 8 smaller bristles. Legs (figs. 19e-g) brown with pale bandings either at base or apex of femora and tibia of first fore legs, hind femora and tibia being totally dark; HFC (fig. 19h) of 4, second from spur longest; tarsal ratio of hind leg 2.5; tarsal claws of mid legs (fig. 19i) not equal to each other with the in between empodium peculiar and reduced to a filiform spinous structure while claws of other legs equal with the in between empodium usual. Wing (fig. 19j) - with yellow brownish areas

Fig. 19. *Gulicoides insulana*, n. sp.; a-k :

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, mid leg claw; j, wing;
k, spermathecae.

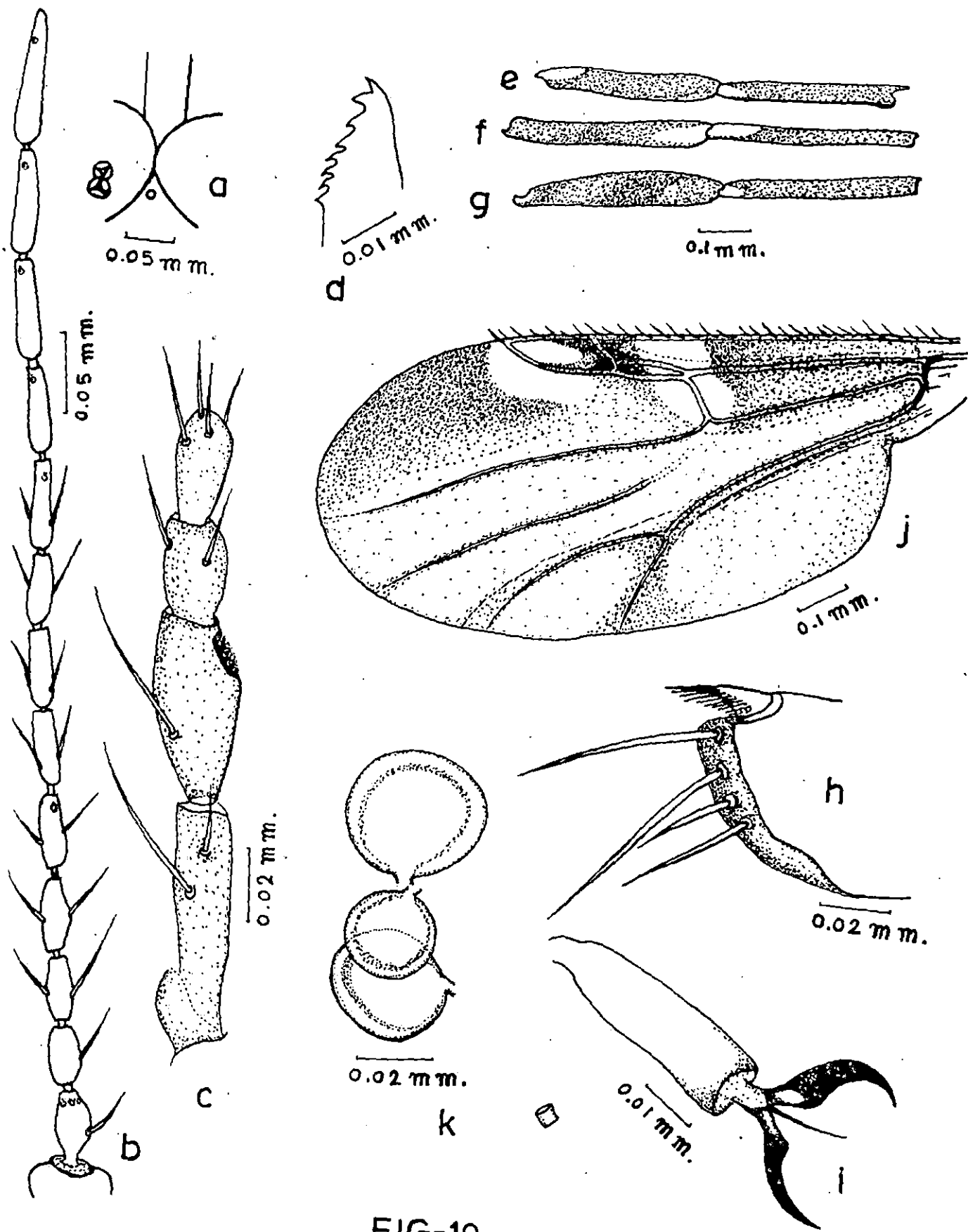


FIG-19

limited to one large blotching at base, one small such covering part of first and second radial cell, one large such covering most of cell R_5 and two such streaks along two branches of the mediocubital fork; anal angle in anal cell also with a blotching; paleness of wing pallor as interconnected areas; macrotrichia stray few; costa extending to 0.69 of wing length. Haltere pale yellowish.

Abdomen - brownish yellow; with three subapical spermathecae (fig. 19k), one smaller than the other two and measuring 0.032×0.024 mm, 0.03×0.024 mm and 0.02×0.022 mm; spermathecal necks narrow, sclerotized at beginning and ring visible.

Male : Unknown.

Distribution : India (Darjeeling town of West Bengal).

Type data : Holotype female (Type No. Ent. Cs 3 PCZM), collected at Govt. College Campus, Darjeeling, on June 4, 1978, by P. P. Choudhuri at light trap; Paratype 4 females, same data as type.

Comments : It remains to be seen if the present species has the habit of attacking mosquitoes as is the case of other members of its group. The unequal tarsal claws with spine-like empodium in between, in its mid legs only, seems to be its very peculiar

feature. Therefore, it is taken as a new species and named C. insolens. Another noteworthy aspect is that it bears distal sensilla coeloconica in III, VII, XI-XV antennomeres only while those in Trithocoides are usually confined to III, XI-XV antennomeres.

B) MACFIEI GROUP OF SPECIES

Calicoides macfieii Causey

Calicoides macfieii Causey, 1959:411.- Sen and Dasgupta, 1958:132 (bloodmeal); 1959b:625 (records, redescription).- Wirth and Hubert, 1959:22 (records, redescription).- Dasgupta, 1961:201 (bionomics).

Female : wing length 1.0 mm, breadth 0.5 mm.

Head - frontovertex brown. Eyes broadly touching, bare. Antenna with average lengths of segments III-XV in proportion of 18-13-14-16-16-17-17-16-25-25-28-28-39; AR 1.14; sensilla coeloconica on III, XI - XV. Maxillary palp with average lengths of segments I-V in proportion of 5-11-13-6-7; segment III moderately swollen, with ill-formed, shallow sensory pit and L/W ratio 2.0 (n = 2). Mandible with 7 (n = 3) teeth, thicker apical and directed inward.

Thorax: Scutum dark brown with scutellum and postscutellum // concolourous. Legs dark brown with broad pale spots at base and apex of all femora and tibiae excepting hind femora which appears totally dark; HTC of 4, second from spur longest; tarsal claws simple.

Wing - light smoky with clear, pale areas as: at r-m, in cell R_5 and most of second radial cell, in distal wing margin extending over cell R_5 and M_1 ; lighter areas in the form of diffused spots prevail in each of cell M_1 , M_2 and M_4 ; macrotrichia scanty; costa extends to 0.68 of wing length. Halteres pale (yellowish/creamy in fresh state).

Abdomen - dark brown. Spermathecae three, somewhat bulbous with middle one largest and measuring 0.052 x 0.047 mm while the other two are almost equal to each other and measure 0.041 x 0.036 mm; necks very broad at beginning, unscerotized and no ring visible.

Male: in genitalia, sternum IX shows imperceptible caudo-medial depression and tergum IX a shallow caudo-medial cleft flanked by short, slender AP directed caudad. Basistyle with small and pointed ventral root, its dorsal root just slender; dististyle slightly incurved and slendering past middle to a pointed tip. Aedeagus massive, its stem and arms are all short, the thicker stem ending bluntly in a flat caudal tip. Parameres separated, each thick basad with distal half however as a filiform, simple piece bending laterad.

Distribution : Thailand; India and Malaya.

Specimens examined : 5 females from Jhargram during 1958 at light by S. K. Dasgupta; also collected from Burdwan in March 1978 at light 3 females by P. P. Choudhuri and S. K. Dasgupta.

Comments : In the present species the paleness of wing apex together with the characteristic bulbous spermathecae of which the lateral two are equal to each other, the uniformly dark brown thorax, a low number of mandibular teeth and a massive aedeagus with very short arms and stem make it quite a distinct and remarkable species of Erithecoidea. It shows rather a limited variation range and seems to enjoy a limited distribution.

The Indian records of the present species is as follows - Jhargram (Sen and Dasgupta, 1959; Dasgupta, 1961-1964) and Burdwan (West Bengal State).

Culicoides mirus, n.sp.

(Figs. 20a-j)

Female: wing length 0.92 (0.9 - 0.96, n = 5) mm, breadth 0.44 (0.42 - 0.48, n = 5) mm.

Head - frontovertex (fig.20a) brown with about 6 setae scattered all over. Eyes almost touching at a point, bare. Antenna (fig.20b) yellowish brown with average lengths of segments III, XI-XV in proportion of 16-13-14-14-15-15-15-

Fig. 20. Culicoides nixus, n.sp.; ♂♂ :

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

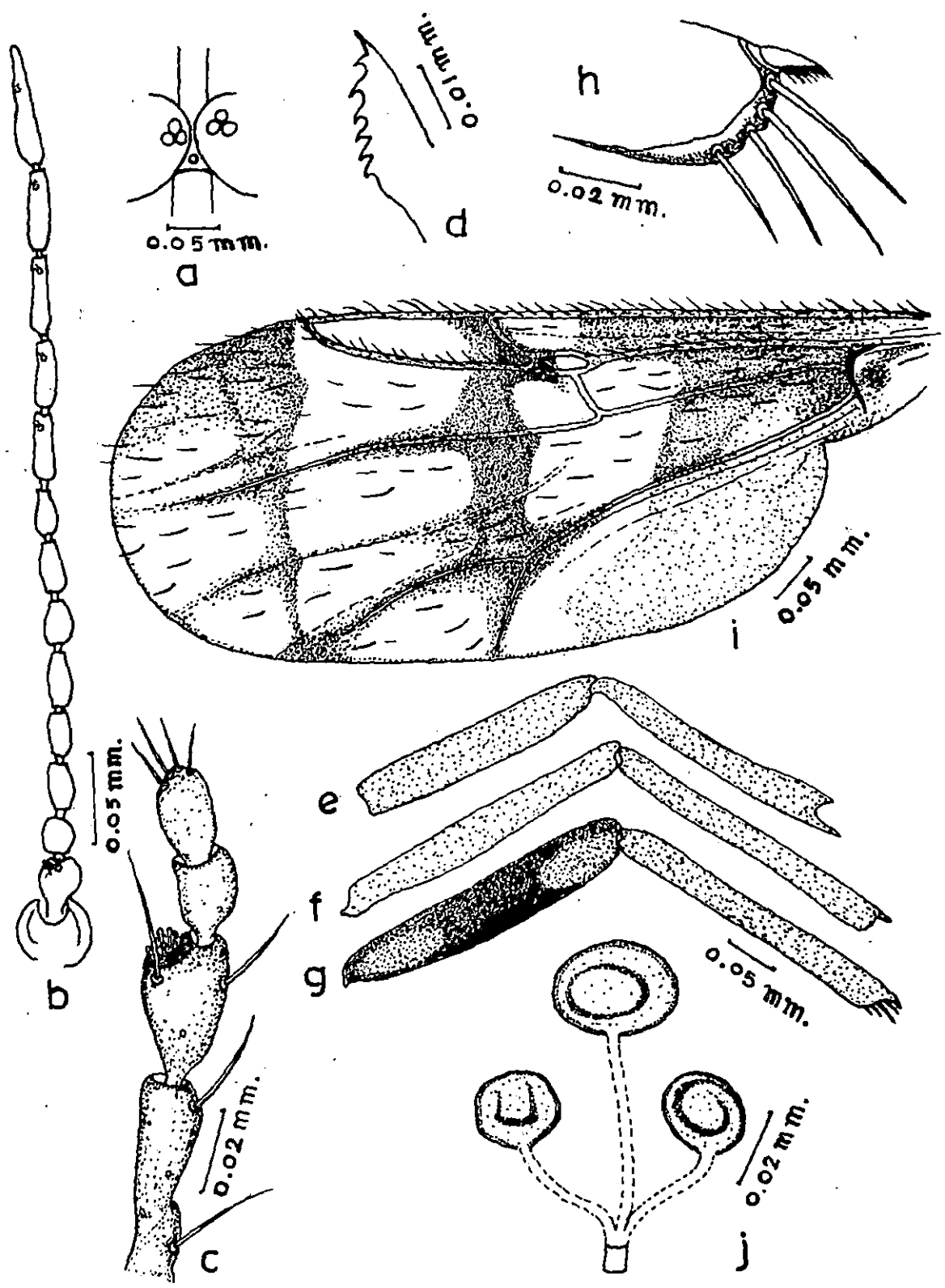


FIG-20

-20-20-21-24-35; AR 1.02; sensilla coeloconica on III, XI - XIV and XV ending in a nipple-like process. Maxillary palp (fig. 20c) with average lengths of segments I-V in proportion of 6-16-17-9-10; segment III enormously swollen apically and with a shallow sensory pit having sensory hairs; L/W ratio 1.7 (1.5 - 1.9, n = 5). Proboscis rather long, F/H ratio 2.00 (1.8 - 2.2, n = 5). Mandible (fig. 20d) with 7 large teeth, mostly directed just inward and basal few thicker.

Thorax - scutum yellowish brown, scutellum with enough bristles of variable size. Legs (figs. 20e-g) brownish throughout, without any perceptible pale mark excepting one apical at distal end of hind femora; HFC (fig. 20 h) of 4, second from spur longest; tarsal ratio of hind legs 1.77 (1.7 - 1.83, n = 4); tarsal claws usual in all legs.

Wing (fig. 20 i) - yellowish brown with fairly large and extensive pale areas characterizing the wing surface; darkish areas as: one patch at base covering most of subcostal and costal cell, one narrow streak extending vertically from costal margin through basal half of second radial cell to the tip of vein Cu_1 and one splash at apicolateral corner in cell R_5 extending down as a narrow streak to vein M_2 ; second radial cell is unusually large and costs extends to 0.63 of wing length; macrotrichia not too scarce, few visible almost in all cell areas of wing surface. Haltere stem and base of the knob infuscated, otherwise pale.

Abdomen -- yellowish brown; with three spermathecae (Fig. 20j) variable in shape, the larger one clearly broader than long and measuring 0.026 x 0.02 mm while the smaller two suboval, equal and measuring each 0.018 x 0.016 mm; spermathecal necks neither perceptibly broad nor sclerotized at the beginning; a prominent ring visible.

Male : unknown.

Distribution : India (Darjeeling town of West Bengal).

Type-data : Holotype female (Type No. Ent. Cs 4, PCZM), collected from Govt. College Campus, Darjeeling, on June 2, 1979, by P. P. Choudhuri at light trap; Paratype 4 females, same data as type.

Comments : The distinctive features of the present species are : sensory hairs in segment III of maxillary palp located in a shallow sensory pit; wing, with a fair number of macrotrichia, extensively pale, the darkish spots/areas practically confined to 3 isolated patches/streaks and second radial cell widely open; legs darkish throughout without any perceptible pale spot in femora and tibia. In view of its several very unusual features, it is taken as a new species and is named G. rina.

Gulicoides neonajifer, n. sp.

(Figs. 21a-n)

Female : wing length 0.96 mm, breadth 0.45 mm.

Head - frontovertex (fig. 21a) dark brown with about 14 oetae scattered all over, Eyes contiguous, bare. Antenna (fig. 21b) brown with average lengths of segments III-XV in proportion of 17-25-15-14-15-15-15-15-21-20-23-23-34; AR 1.00; sensilla coeloconica usual, on III, XI-XV. Maxillary palp (fig. 21c) with average lengths of segments I-V in proportion of 6-18-15-9-10; segment III enormously swollen at middle and beyond with sensory hairs restricted to a central area past middle and alveoli of some of these hairs confluent to form one ill-defined sensory pit; L/W ratio 1.66. Proboscis very long, P/H ratio 1.87. Mandible (fig. 21d) with 7 widely spaced teeth hardly directed inward and apical few thicker.

Thorax - scutum pale yellow, scutellum dark brown. Legs (fig. 21e-g) brown excepting that hind tibia totally pale, broad basal paleness of first two tibia and mid femora, and similar apical paleness of first two femora; HFC (fig. 21h) of 4, second from spur longest; tarsal ratio of hind legs 2.2; tarsal claws usual in all legs.

Wing (fig. 21 i) - brownish to dark brown with pale markings save for 2 or 3 rather vague and no extensive interconnected areas;

Fig. 21. Gulicoides nepalrifex, n.sp.; a-n:

Female - a, frontovortex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

Male - k, wing; l, genitalia (aedeagus
and parameres removed); m, aedeagus;
n, parameres.

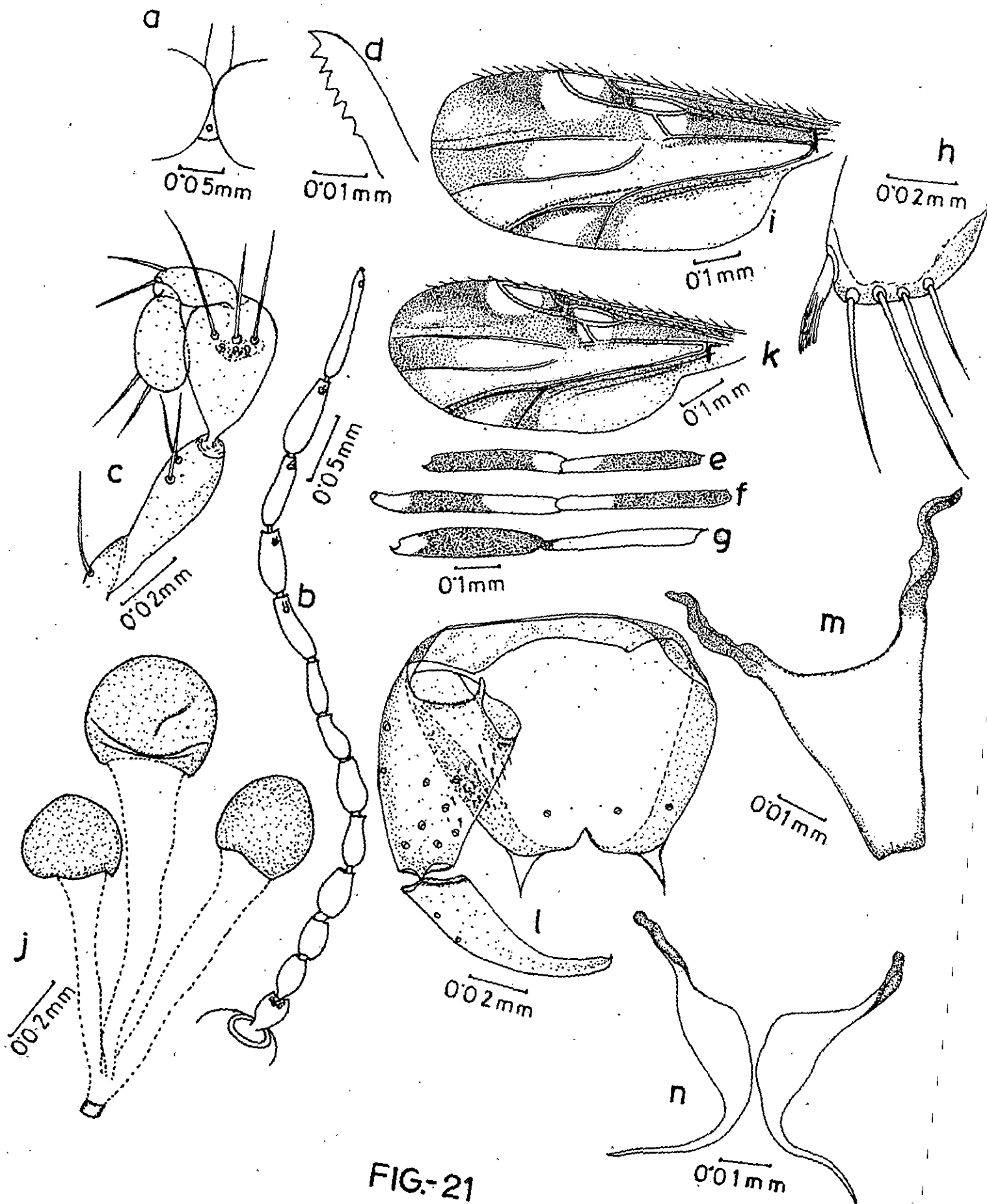


FIG-21

cell R_5 with one roundish, small pale spot near apical margin and another bigger one at second radial cell is distinctive; one pale spot at r-m extending to costal margin and whole of cell M_2 , basal half of cell M_1 and most of cell M_4 and anal cell appear pale; macrotrichia very scanty, almost confined to radial vein and its branches; costa extends to 0.68 of wing length. Haltere knob pale, stem dark.

Abdomen - dark brown; with three spermathecae (fig. 21 j), the larger one appear broader than long, measuring 0.026×0.025 mm and the smaller two measuring 0.019×0.019 mm and 0.018×0.018 mm.; spermathecal necks showingly broad but unclerotized from beginning and a small ring visible.

Male : Wing (fig. 21k) measures 0.67×0.38 mm.

Genitalia (figs. 21 l-n) - sternum IX with a perceptible caudomedial depression and ventral membrane extending from it bare; tergum IX short-sized and stout, with a prominent cleft at the middle of its caudal margin and a pair of acuminate AP directed backward. Basistyle with slender dorsal root but the ventral root imperceptible; dististyle gently incurved and gradually slendering to a finely pointed tip. Aedeagus (fig. 21 m) simple, conical with prominent, slender arms and its stem not perceptibly marked off from its body with the stem-tip thick,

blunt and flat. Parameres (fig. 21 n) separated, each with conical stem that extends caudad to a simple, bare, filiform process curved laterad.

Distribution : India (Darjeeling town of West Bengal).

Type-data : Holotype female (Type No. Ent. Ga 5 PCZN), collected from Govt. College Campus, Darjeeling, at light trap on June 2, 1978, by P. P. Choudhuri; Allotype male, on September 4, 1978; other data as type; Paratype 10 females, 6 males collected in March - September 1978; other data as type.

Comments : The present species closely resembles G. palnifer Dasgupta and Ghosh. Its distinctive features include somewhat characteristic wing colouration with 3 well-formed pale spots in wing area above the level of medial vein and its first branch (vein M_1), highly inflated third palpal segment and characteristic leg colouration having hind tibia totally pale and mid femora and mid tibiae with very broad, apical/basal pale spot. The lower half of wings comprised of cell M_2 to anal cell is almost entirely pale with dark pallier visible only around the veins and this makes its separation easy. It is, therefore, named as G. neopalnifer in recognition of its closeness with G. palnifer and taking it as a new species.

Gulicoides palpifer Dasgupta and Ghosh

Gulicoides palpifer Dasgupta and Ghosh, 1956a : 122.-

Wirth and Hubert, 1959: 25.- Delfinado, 1961:668.-

Lee, 1979 : 98-107 (record px Tibet)

Female : wing length 0.94 mm, breadth 0.44 mm.

Head - frontovertex brown with about 12 setae scattered all over. Eyes broadly touching, bare. Antenna with average lengths of segments III-XV in proportion of 12-9-9-9-9-9-9-13-11-16-14-23; AR 1.02; sensilla coeloconica on III, XI-XV and segment XV ending in a well-shaped nipple-like process. Maxillary palp with average lengths of segments I-V in proportion of 3-10-9-5-7; segment III just swollen in its middle though short, having near distal end a shallow, pit-like area wherein some sensory hairs are placed and L/W ratio 2.0 (1.7 - 2.2, n = 10). Maxillary blade with 11 (10-13, n = 10) teeth, not always confined to a row only and thicker distad. Mandible with ? (6-7, n = 10) teeth, apical one very thick and directed forward, others slightly incurved.

Thorax - dorsal aspect of scutum entirely shining yellow, scutellum light brown while postscutellum and lower half of pleuron brown; 3 stout bristles on scutellum. Legs dark brown with narrow subapical and subbasal pale bands on first fore femora while hind femora almost totally dark; first fore tibiae with broad subbasal pale band while hind tibiae appear totally pale; HTC of 4, second from spur longest; tarsal ratio of hind leg 1.95; tarsal claws simple.

Wing - brownish with pale areas as; at base, at r-m, two in cell R_5 of which the proximal one covers most of second radial cell, in each of cell M_1 , M_2 , M_4 and anal cell - those in cell M_1 and M_2 very extensive; macrotrichia scanty; costa extends to 0.62 of wing length. Halteres pale to just infuscated.

Abdomen - brown. Spermathecae three of variable shape, the larger one 0.035×0.03 mm while the other two smaller and almost equal with average measure of 0.025×0.02 mm ($n = 10$); necks wide, un sclerotized and ring visible.

Male : similar to female with usual sexual differences. Wing measures 0.8×0.5 mm.

Genitalia - sternum IX with a shallow caudomedial depression; tergum IX bears a caudomedial notch flanked by large, slender AP directed backward. Basistyle with slender dorsal root, its ventral root not visibly demarcated; dististyle incurved, acuminate at tip. Aedeagus with thick stem ending in a blunt tip, its basal arms slender though stout. Parameres separated, each with short, stout stem slendering to a simple, fine extremity directed ventrolaterad.

Distribution : India; Malaya, North Borneo, Philippines, Sarawak, Sumatra, Taiwan, Thailand and Tibet.

Specimens examined : INDIAN FORMS - 10 females and 4 males from Thakurpukur by rearing from rotting banana vegetation during September 1955, 7 females and 2 males by hand net/light trap from Dum Dum in October 1956, and 4 females and 7 males at light trap from Kanchrapara during March 1958 - all collected by S.K. Dasgupta around Calcutta and kept in slide-mounts; also collected 11 females, 4 males from Batanagar, Chinsura, Burdwan and Siliguri College Campus, Siliguri, during 1976 and 1978 by S. K. Dasgupta and P. P. Choudhuri at light/sticky trap/rearing from rotting banana vegetation. EXOTIC FORMS - 5 females, 1 male collected from Malaya, 1 female from Thailand, 1 female from Sarawak and 2 females from Philippine Is., during April - November 1958 by light trap - all received slide mounts from Dr. Wirth.

Comments : Within the group it belongs to C. nalpifer resembles C. humeralis Okada in some essential aspects. But its mandibular tooth-pattern, all yellow scutum and very distinctive type of parameres of male genitalia immediately separates it from others. Quite extensively distributed in Southeast Asia, it is noted for its variability.

The Indian records of C. nalpifer to the data may be listed as follows : Thakurpukur, Dum Dum and Kanchrapara areas in the suburb of Calcutta (Sen and Dasgupta, 1959; Dasgupta, 1961-1964); also collected from Siliguri town, in the northern part of West

Bengal State, and from Burdwan, Chinsura and Hatanagar, in the southern part. According to Wirth (1959), the record of the Ethiopian species, *C. fulvithorax* (Austen) from Assam by Smith and Swaminath (1932) was misidentification the specimens involved probably belonged to *C. nalisifer* as the description indicated.

Culicoides narisalisifer, n.sp.

(Figs. 22a-n)

Female : wing length 1.00 mm, breadth 0.46 mm.

Head - frontovortex (Fig. 22a) brown to brownish with about 6 large and 4 small setae scattered over it. Eyes contiguous for a distance equal to the diameter of 3 facets, hairy. Antenna (fig. 22b) brownish yellow with average lengths of segments III-XV in proportion of 15-12-12-14-17-15-15-21-20-22-26-37; AR 1.09; sensilla coeloconica on III, XI-XV and segment XV ending in a well-shaped nipple-like process. Maxillary palp (fig. 22c) with average lengths of segments I-V in proportion of 7-22-16-9-10; segment III short, just swollen past middle that bears stray sensory hairs each arising from its own alveolus and there being no sensory pit in the segment; L/W ratio 2.00. Proboscis moderately long, P/H ratio 1.85. Mandible (fig. 22d) with 6 teeth feebly incurved and apical ones thicker.

Thorax - scutum brown to brownish with 3 longitudinally disposed darkish vittae; scutellum adorned with stray bristles of varying sizes. Legs (figs. 22e-g) brown to brownish with

Fig. 22. Culicoides parannulifer, n. sp.; a-n :

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

Male - k, wing; l, genitalia (aedeagus
and parameres removed);
m, aedeagus; n, parameres.

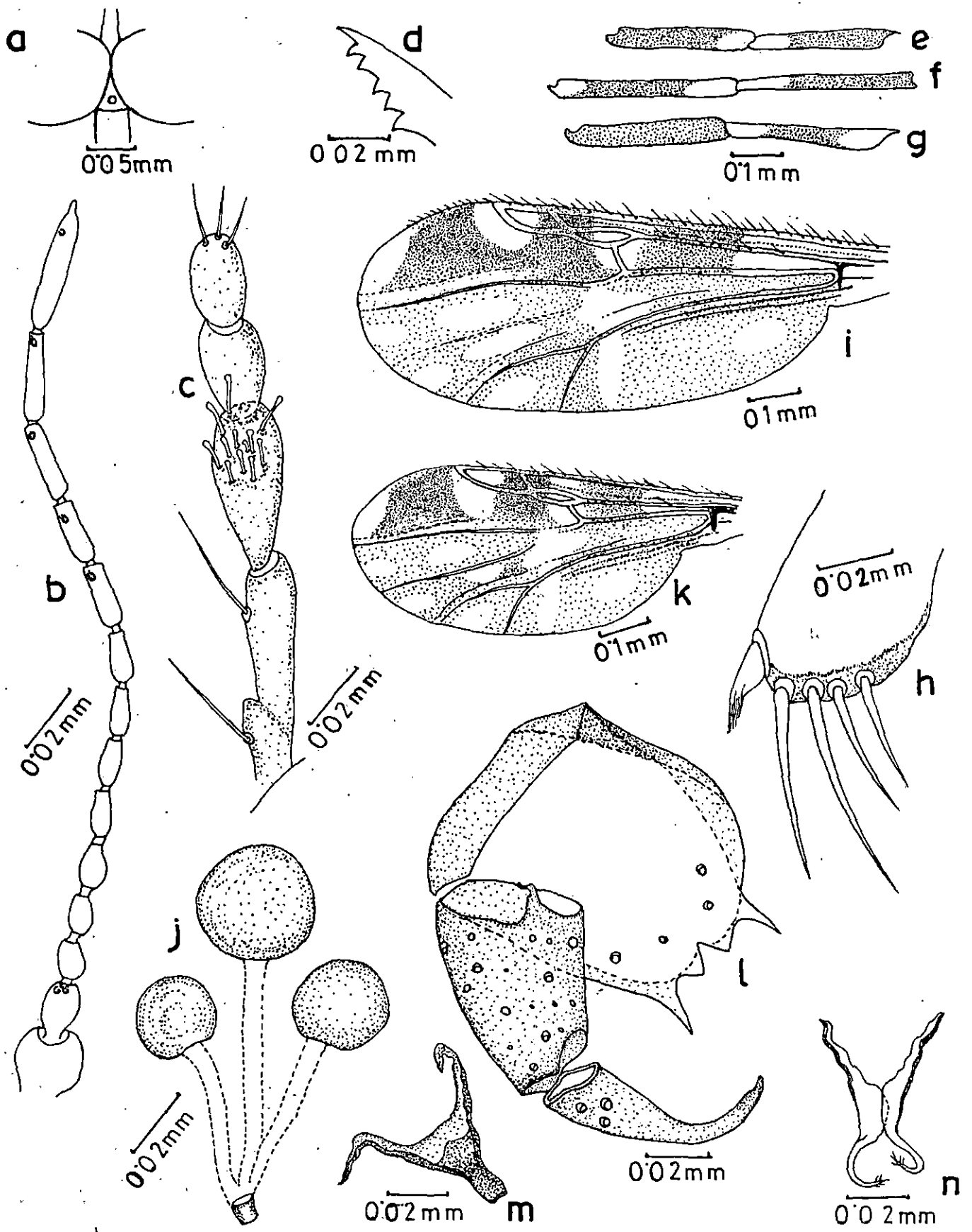


FIG-22

subbasal/subapical pale spot in femora and tibia of first four legs; hind femora totally dark and hind tibia with broad subbasal and subapical pale spot; HFC (fig. 22h) of 4, second from spur longest; tarsal ratio of hind legs 2.4; tarsal claws usual in all legs.

Wing (fig. 22 i) - brownish with isolated pale spots as figured; pale area at wing base covering proximal part of all trunk veins, at r-m extending to costa, at apical half of second radial cell, at apical margin of wing in cell R_5 , two each in cell M_1 and M_2 , in cell M_4 and behind vein Cu_1 , at base of anal cell; macrotrichia confined to radial vein with stray few in cell R_5 ; costa extends to 0.68 of wing length. Halteres knob pale, stem dark.

Abdomen - brown; with three spermathecae (fig. 22j) of a variable shape, the larger one measuring 0.024 x 0.024 mm and the other two as 0.018 x 0.016 mm and 0.016 x 0.016 mm; spermathecal necks un sclerotized and not palpably broad at beginning, a ring visible.

Male ; wing (fig. 22k) measures 0.8 x 0.36 mm.

Genitalia (figs. 22 l-n) - sternum IX feebly depressed caudomedially, without any excavation; tergum IX with a prominent caudomedial cleft and two acuminate AP. Basistyle stout with a

small, somewhat hook-shaped ventral root; dististyle incurved at middle and its distal half slender, tapering to a point. Aedeagus (fig. 22 m) with long, slender arms and its stem short and marked off from its body and ending in a blunt, flat tip. Parameres (fig. 22 n) separated, each with caudal and filiform and bearing few small spines to pointed tip.

Distribution : India (Balurghat town of West Dinajpur District, West Bengal).

Type-data : Holotype female (Type No. Ent. Cs 6 FCZH), collected from College Campus, Balurghat, West Dinajpur, on June 23, 1978 by P. P. Choudhuri at light trap; Allotype male, on June 9, 1978 and Paratype 2 females, 3 males; data same as type.

Comments : The distinctive features of the present species are : well-set, distinguishable 8-9 pale spots on wing surface, hind leg with totally dark femora while tibia marked by broad pale spots at two ends and spinose tips of parameres of male genitalia. It is, therefore, taken as yet another new species of Collepides, related to C. palnifer Dasgupta and Ghosh and named as C. parapalnifer.

Culicoides pseudopalmaris, n. sp.

(Figs. 23a-m)

Female : wing length 0.96 (0.92 - 0.98, n = 4) mm, breadth 0.44 (0.42 - 0.46, n = 4) mm.

Head - frontovertex (fig. 23a) light brown with about 10 setae scattered all over. Eyes broadly separated, bare. Antenna (fig. 23b) light brown with darker splashes at base of most segments and average lengths of segments III-XV in proportion of 17-15-15-15-15-15-15-20-20-24-24-39; AR 1.08 (1.02-1.1, n = 3); sensilla coeloconica on III, XI-XV and may also be on segment V and VII. Maxillary palp (fig. 23c) with average lengths of segments I-V in proportion of 6-19-16-10-11; segment III swollen past middle but without a sensory pit and stray sensory hairs at middle or beyond in segments III-IV; L/W ratio 2.0 (1.8 - 2.1, n = 3). Proboscis long, P/H ratio 1.85 (1.65 - 1.95, n = 3). Mandible (fig. 23d) with 7 widely spaced, just incurved teeth with apical ones thicker.

Thorax scutum brown; scutellum with 6 large and 4 small bristles. Legs (figs. 23 e-g) brown with mid femora mostly pale from base while hind femora is totally dark; fore tibia with subapical but hind tibia with subapical and subbasal pale spots while mid tibia totally dark; BTG (fig. 23h) of 4, second from spur longest; tarsal ratio of hind legs 2.2 (1.98 - 2.4, n = 5); tarsal claws usual in all legs.

Fig. 23. Gulicoides pseudopalmeri, n.sp.; a-z:

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

Male - k, genitalia (aedeagus and
parameres removed); l, aedeagus;
m, parameres.

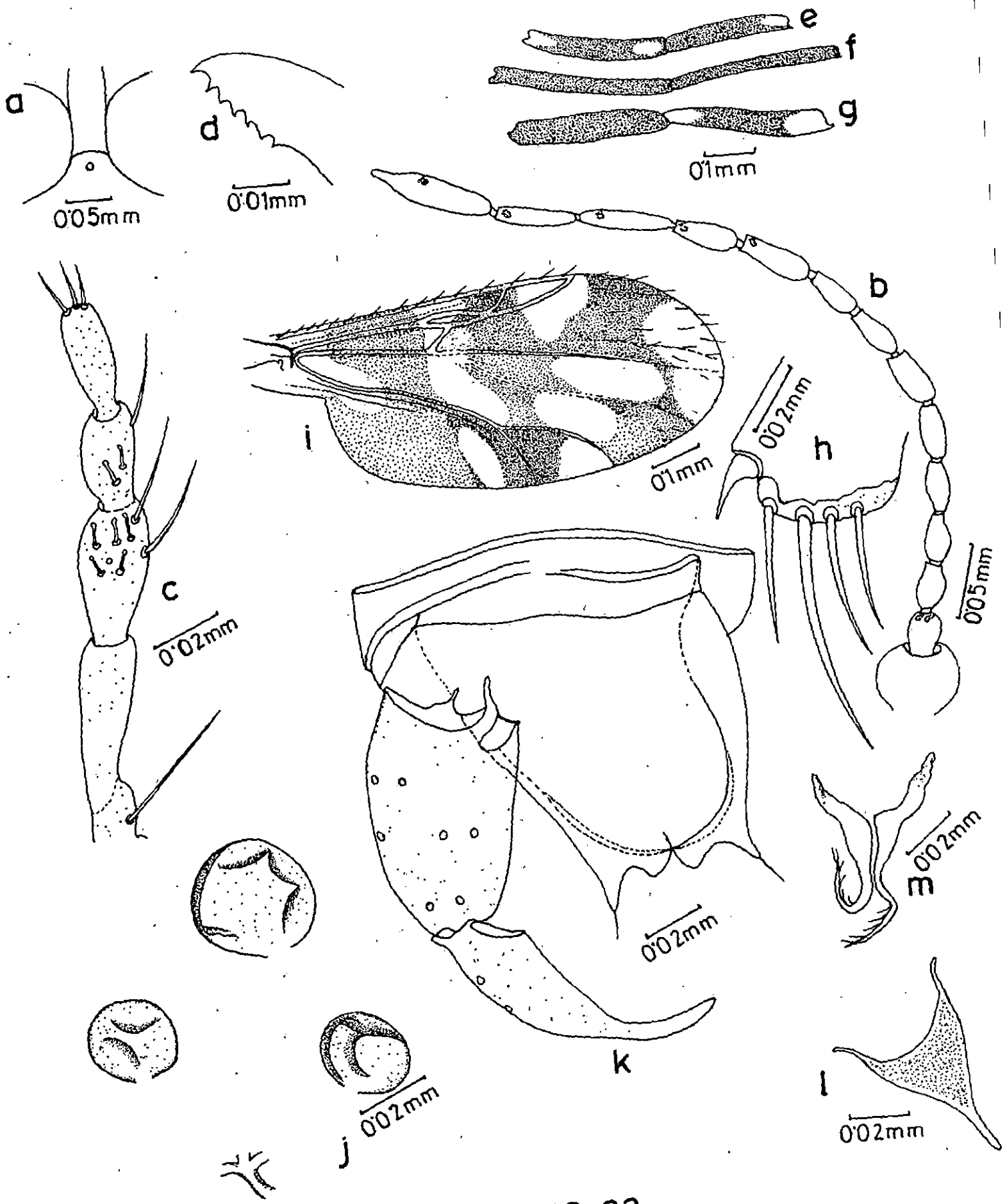


FIG-23

Wing (fig. 25 i) - brown to brownish with pale spots as figured with one at base, at r-m that continues down to medio-cubital fork, in cell R_3 covering apical half of second radial cell, one each in cell M_1 , M_2 , M_3 and anal cell; one very broad pale spots covers the apex of cell R_5 and M_2 ; the pale spots are in the form of well-formed, large and mostly disparate spots; macrotrichia stray few in cell R_5 only; costa extends to 0.66 (0.68 - 0.69, n = 4) of wing length. Haltere pale.

Abdomen - dark brown; with three spermathecae (fig. 23 j) spherical to subspherical, unequal and the larger one measuring 0.026 x 0.026 mm while the smaller two measured 0.019 x 0.016mm and 0.018 x 0.018 mm; spermathecal necks apparently narrow, unsclerotized and a large ring ending in 3 small branches proximally visible.

Male : in genitalia (figs. 23 k-n), sternum IX with a slight caudomedial depression and ventral membrane extending from it finely spiculate; tergum IX long, with a cleft in the middle of its caudal margin and two acuminate AP just divergent. Basistyle with well formed internal roots; dististyle stout at basal two-third and then bent inwards abruptly slendering into a short, slender process. Aedeagus (fig. 23l) with very slender though longish arms and stem, the stem ending into a finely rounded

caudal tip. Parameres (fig. 23 m) separated, each stout at base that extends caudad into a sinuate stem ending in a filamentous, spinose tip.

Distribution : India (Darjeeling town of West Bāngal).

Type-data : Holotype female (Type No. Ent. Cs 7 PCZM), collected from Govt. College Campus, Darjeeling, at light trap on June 1, 1978, by P. P. Choudhuri; Allotype male, on September 4, 1978; other data as type; Paratype 3 females, in March - September 1978; other data as type.

Comments : The present species resembles C. unifier Dasgupta and Ghosh in many respects. The broadly separated inner eye margins, stray, isolated sensoria in III and IV segments of the maxillary palp, characteristic wing and leg colouration and spinose tip of parameres of male genitalia in the present species, however, make it significantly different and on these basis, taking it as a new species, it is named C. pseudounifier.

Gulicoidea nussinalifer, n.sp.

(Figs. 24a-j)

Female : wing length 1.08 mm, breadth 0.53 mm.

Head - frontovertex (fig. 24a) yellow brown with about 4 big and 6 small setae scattered over it. Eyes narrowly contiguous with short, sparse interfacetal hairs. Antenna (fig. 24b) yellowish with average lengths of segments III-XV in proportion of 17-14-14-15-16-16-16-16-22-24-23-25-39; AR 1.07; sensilla coeloconica on III, XI - XIV and segment XV ending in a well-shaped nipple-like process. Maxillary palp (fig. 24c) with average lengths of segments I-V in proportion of 8-22-19-10-10; segment III short and stout, progressively swollen from base apically with sensory hairs clustered in a shallow sensory pit subapical. Proboscis moderately long, P/H ratio 1.85. Mandible (fig. 24d) with 7 subequal, thick teeth directed outward.

Thorax - pale brown; scutum yellowish, scutellum brownish and without any pattern. Legs (fig. 24 e-g) brown with hind tibia totally pale, mid tibia with broad pale spots at both ends but mid femora with such spot at apical end only and in fore femora and tibia, no perceptible pale spot as these parts were lightly shaded throughout; HTC (fig. 24h) of 4, second from spur longest; tarsal ratio of hind legs 2.25; tarsal claws usual in all legs.

Fig. 24. Culicoides marginalis sp. n.; a-j :

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

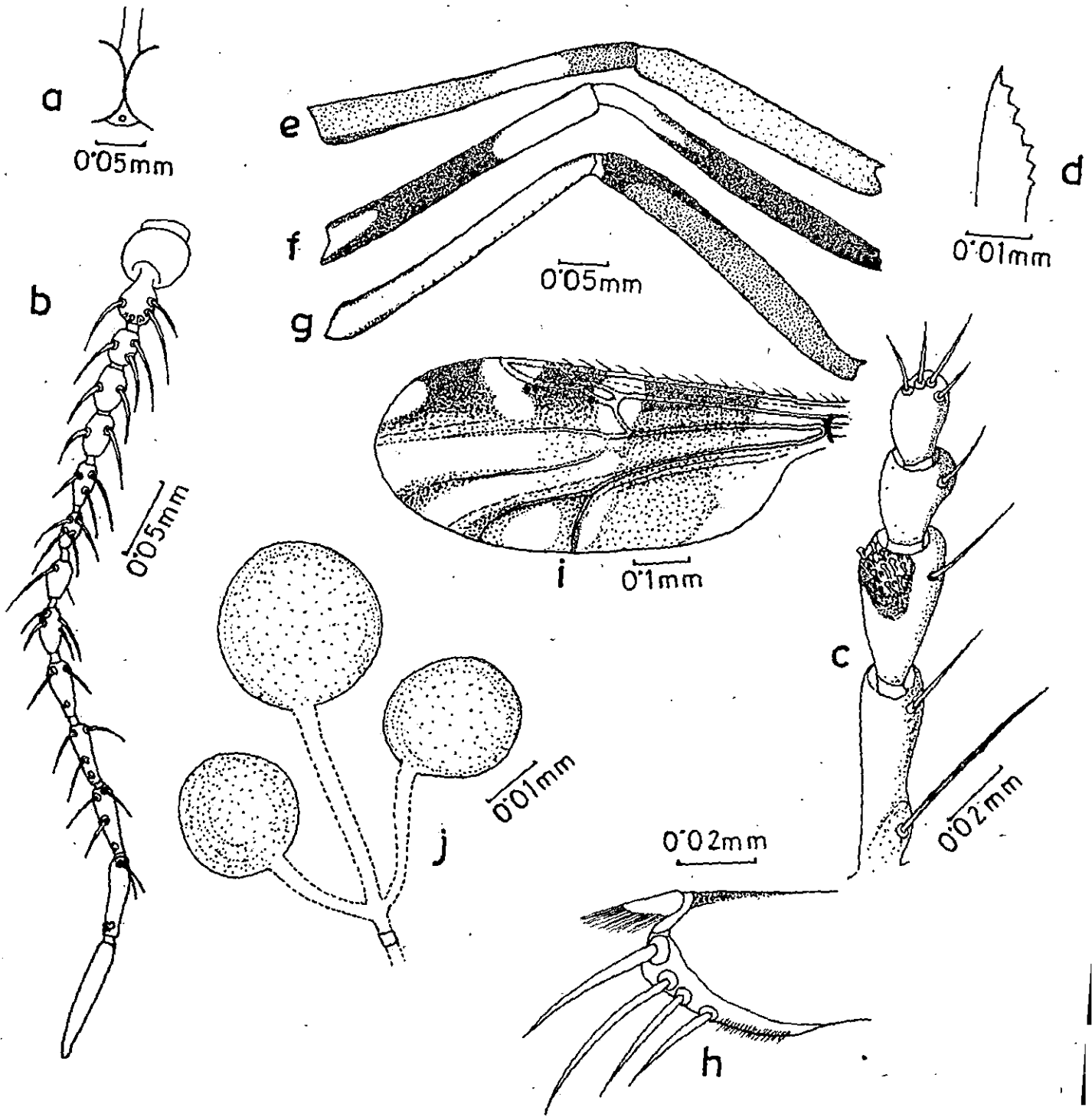


FIG-24

Wing (fig. 24 i) - yellowish brown with pale spots/areas as figured - one extensive pale area at base, a pale spot each at r-m, at second radial cell and at apical corner of cell R₅, at cell M₄ and behind vein Cu₁; cell M₁ and M₂ are almost totally pale; macrotrichia seems confined to radial vein only; costa extends to 0.7 of wing length. Haltere pale.

Abdomen - yellowish brown; with three spermathecae (fig. 24 j) semispherical and slightly longer than broad, the larger one measuring 0.027 x 0.025 mm while the other two as 0.021 x 0.018 mm and 0.019 x 0.018 mm; a narrow ring visible.

Male : unknown.

Distribution : India (Darjeeling town of West Bengal).

Type-data : Holotype female (Type No. Ent. Cs 8 PCZN), collected from Govt. College Campus, Darjeeling, on June 10, 1978, by P. P. Choudhuri at light trap; Paratype 9 females, same data as type.

Comments : The distinctive features of the present species are : characteristic leg and wing colouration, the pale mark at apical corner in cell R₅ reduced to a very small spot while cell M₁ and M₂ are unusually pale throughout. While its basic feature

pattern places it near to C. palpifer Dasgupta and Ghosh and the related ones, reported now in this thesis, it is unmistakably a new species akin to C. palpifer for which it is named C. quasipalpifer.

Culicoides narisenitalis, n.sp.

(Figs. 25 a-n)

Female : wing length 1.16 mm, breadth 0.54 mm.

Head - frontovertex (fig. 25a) yellowish brown with about 2 large and 6 small setae scattered over it. Eyes broadly contiguous, bare. Antenna (fig. 25b) yellowish with average lengths of segments III-XV in proportion of 17-14-15-15-16-17-18-17-23-23-22-22-39; AR 0.99; sensilla coeloconica on III, VI, XI-XIV and XV ending in a well-shaped nipple-like process. Maxillary palp (fig. 25c) with average lengths of segments I-V in proportion of 7-20-19-10-9; segment III long, swollen subapically having an ill-formed, shallow sensory pit housing stray sensory hairs; L/V ratio 2.2. Proboscis very long, P/H ratio 2.07. Mandible (fig. 25d) with 7 large, incurved teeth and apical ones thicker.

Thorax - scutum yellowish brown without a pattern; scutellum with several bristles of variable sizes. Legs (figs. 25 e-g) with colour pattern as in C. naripalpifer, the shade darker; HTC (fig. 25 h) of 4, second from spur longest; tarsal ratio of hind legs 2.33; tarsal claws usual in all legs.

Fig. 25. Gulicoides pariscutalis, n.sp.; a-m :

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

Male - k, wing; l, genitalia (aedeagus
and parameres removed);
m, parameres; n, aedeagus.

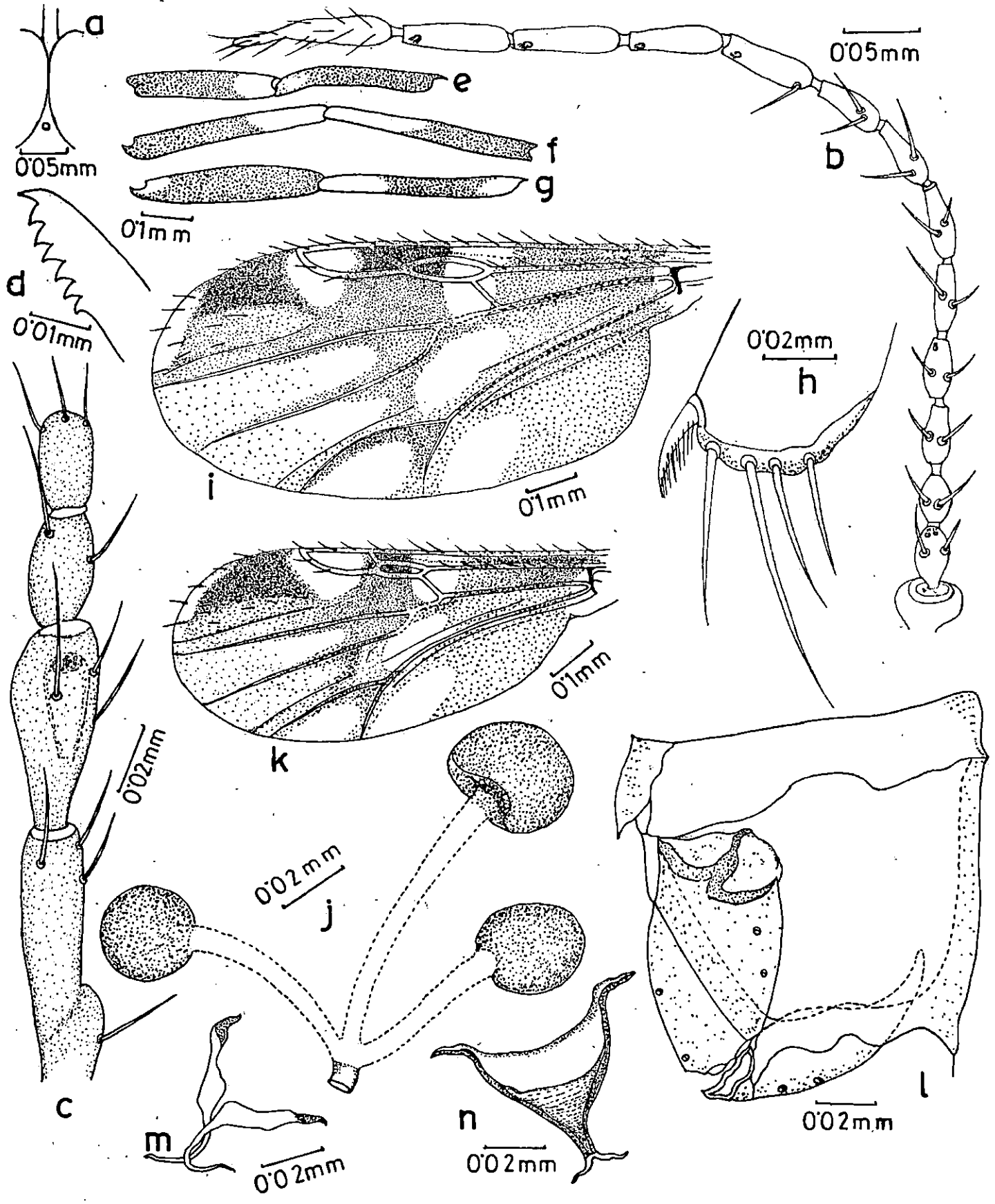


FIG-25

Wing (fig. 25 i) - yellowish brown with pale spots as :
 at r-m extending to costa, at apical half of second radial cell,
 at apical margin in cell R_5 as a narrow streak, in cell M_4 , behind
 vein Cu_1 in anal cell and above mediocubital fork; cell M_1 and M_2
 appear without any paleness though one vague spot of such nature
 may be made out at their bases; macrotrichia sparse though quite
 a number visible in cell R_5 ; costa extends to 0.68 of wing length.
 Haltere yellowish throughout.

Abdomen - dark yellowish brown; with three unequal spermathecae
 (fig. 25 j) of a variable shape, the larger one measuring 0.023 x
 0.022 mm and the other two as 0.019 x 0.017 mm and 0.018 x 0.017 mm;
 spermathecal necks un sclerotized, somewhat broad at beginning and a
 ring visible.

Male : similar to female with usual sexual differences. Wing
 (fig. 25 k) measures 0.94 x 0.41 mm.

Genitalia (figs. 25 l-n) - sternum IX with a shallow depression
 in the middle of its caudal margin; tergum IX with a medial notch
 and a pair of short, acuminate AP at caudal margin. Basistyle
 with a slender, somewhat crooked ventral root, its dorsal root
 imperceptible; dististyle very stout for most part, incurved and
 slendering at its apical fourth, its tip finally rounded. Aedeagus
 (fig. 25 m) body massive with small, slender arms, its stem also short
 and slender but bifurcated peculiarly at bare tip into two short,

filiform processes that are curved altered. Parameres (fig. 25 n) separated, stem of each extending into a long filiform process which is simple, bare and apically outcurved.

Distribution : India (Jhargram town of Midnapore district, West Bengal).

Type-data : Holotype female (Type No. Ent. Co 9 PGZM), collected from Govt. College Campus, Jhargram, on June 2, 1979, by P. P. Choudhuri and S. K. Dangupta at light trap; Allotype male, on September 4, 1979, other data as type; Paratype 11 females, 6 males in March - September 1979, other data as type.

Comments : the distinctive features of present species are : no clear-cut pale spots in wing surface below the level of medial vein and its first branch and cell R_5 with quite a number of macrotrichia, sensory hairs arising from a sensory pit in segment III of maxillary palp and male genitalia outstanding in having a very stout aedeagus whose stem-tip is bifid and drawn into two short, slender processes that are simple, bare and directed laterad. It is on basis of this unusual genitalic aspect that the present species is taken as a new species and is named *C. varizenitalis*. In several respects, specially in leg and wing colouration, it resembles the other new species *C. parapsalifer*, described from the northern plains of West Bengal.

Gulicoides subnivalis, n.sp.

(Figs. 26a-j)

Females : wing length 1.02 mm, breadth 0.5 mm.

Head - frontovertex (fig. 26a) dark brown with about 12 setae scattered all over. Eyes contiguous for a distance equalling the diameter of 3 facets, bare. Antenna (fig. 26b) brown with average lengths of segments III-XV in proportion of 16-14-14-14-14-15-16-16-20-21-22-24-35; AR 1.02; sensilla coeloconica on III, XI-XIV and XV ending in a well-formed nipple-like process. Maxillary palpi (fig. 26 c) with average length of segments I-V in proportion of 6-17-17-8-7; segment III progressively swollen apicad, its drumstick like sensory hairs arising there in respective alveolus there being no sensory pit visible; L/W ratio 1.8. Proboscis very long, P/H ratio 1.33. Mandible (fig. 26d) with 7 teeth directed outward, basall few thicker.

Thorax - scutum yellow, scutellum dark brown with stray bristles of variable size. Legs (figs. 26e-g) brown with fore and mid femora broadly pale apicad, fore and mid tibia so basad and while hind femora totally dark, hind tibia appears mostly pale; HFC (fig. 26 h) of 4, second from spur longest; tarsal ratio of hind legs 2.4 (2.2 - 2.6, n = 5); tarsal claws usual in all legs.

Fig. 26. Colicoides submelnicus, n.sp.; a-j :

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wings; j, spermathecae.

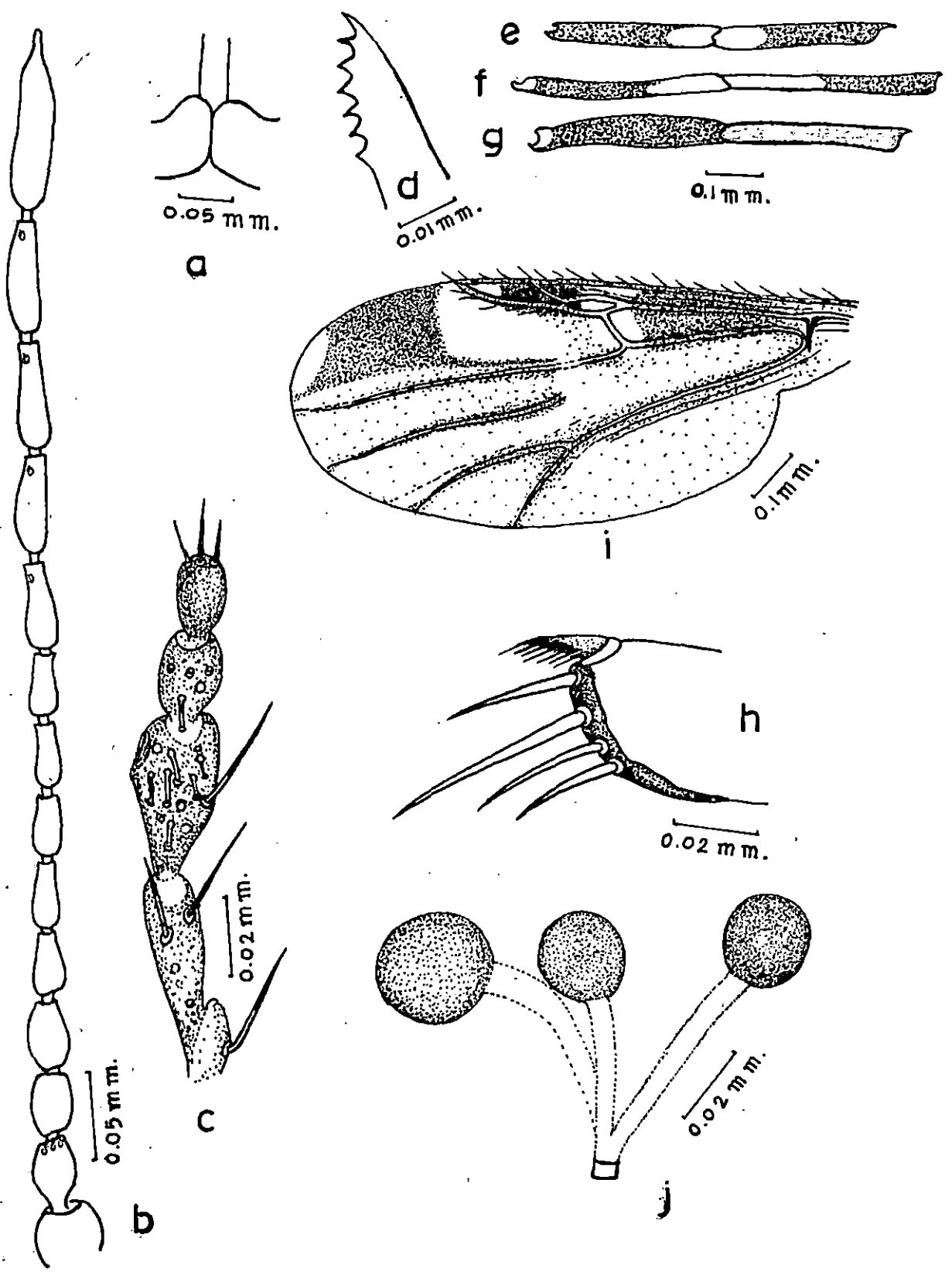


FIG-26

Wing (fig. 26 i) - yellowish with darkish pallor visible as: at base covering most of costal and subcostal cell, part of two radial cells and apical half of cell R_5 save for a very small pale spot at apical margin of the cell; macrotrichia confined to radial cell and its branches; costa extends to 0.68 of wing length. Haltere knob yellow.

Abdomen - yellowish brown; with three spermathecae (fig. 26 j) semispherical and unequal, the larger one measuring 0.028 x 0.024 mm and the other two as 0.018 x 0.018 mm and 0.016 x 0.016 mm; spermathecal necks unsclerotized and broad at beginning; a narrow ring visible.

Male : unknown.

Distribution : India (Darjeeling town of West Bengal).

Type-date : Holotype female (Type No. Ent. Co 10 PCZM), collected from Govt. College Campus, Darjeeling, on June 10, 1978, by P. P. Choudhuri at light trap; Paratype 3 females, date same as type.

Comments : The present species is similar to *G. palpifer* Dasgupta and Ghosh and the related ones in the Macfiei Group. However, its distinctive features are : extensively pale wing with palpable dark spots confined to the wing surface above the medial vein and its first branch; characteristic leg colouration with

hind femora dark but the hind tibia pale in entire. It is therefore taken as a new species and named C. subnoleifer.

C) FLAVESCENS GROUP OF SPECIES

Culicoides innerunguis, n.sp.

(Figs. 27a-n)

Female : wing length 0.8 mm, breadth 0.4 mm.

Head - frontovertex (fig. 27a) brown to brownish with about 8 large and 4 small setae scattered all over. Eyes narrowly separated. Antenna (fig. 27b) brownish with average lengths of segments III-XV in proportion of 12-8-8-8-2-10-10-10-11-16-16-18-19-29; AR 1.27; sensilla coeloconica on III, XI-XIV and XV ending in an ill-formed nipple-like process. Maxillary palp (fig. 27c) with average lengths of segments in proportion of 6-18-16-10-8; segment III progressively swollen till middle and then tapered to a conical apical end bearing a shallow sensory pit housing stray sensory hairs: L/W ratio 2.66. Proboscis moderately long, P/H ratio 1.5. Mandible (fig. 27d) with 18 minute teeth slightly incurved.

Thorax - scutum brown to brownish with stray, darker marks, scutellum without any large bristles. Legs (figs. 27 e-g) brown to brownish with pale bands as figured; HTC (fig. 27h) of 6, first from spur longest; tarsal ratio of hind legs 1.6; tarsal claws in mid legs unequal (one long, slightly curved and the other short, sickle-shaped) but equal in other legs (fig. 27 i)

Fig. 27. Gulicoides inparvus, n.sp.; a-h:

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, 5th tarsomere and claws of
mid leg; j, wing; k, spermathecae.

Male - l, wing; m, genitalia (parameres
removed); n, parameres.

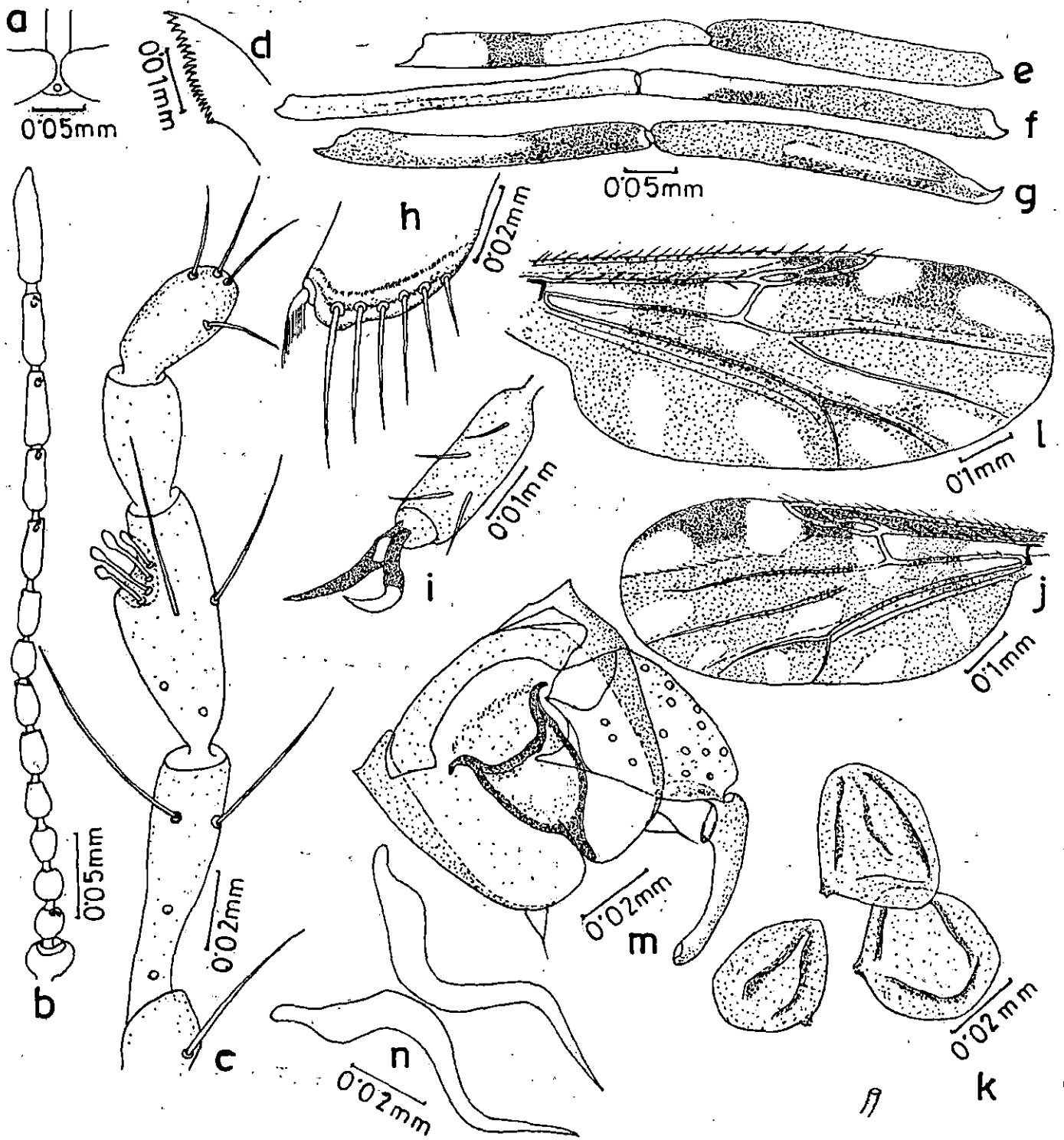


FIG-27

Wing (fig. 27j) - light brown with somewhat indistinct pale spots as figured: one small at extreme base, at r-m and apical end of second radial cell, at apical margin of cell R_5 , two in anal cell and one above medio-cubital fork; macrotrichia confined to radial vein only; costa extends to 0.6 of wing length. Haltere knob pale.

Abdomen - light brown; with three spermathecae (fig. 27k) almost equal, subspherical and measuring 0.032 x 0.028 mm, 0.028 x 0.028 mm and 0.028 x 0.024 mm; spermathecal necks not broadened, sclerotized at beginning; a prominent ring visible.

Male: wing (fig. 27l) measures 1.2 x 0.5 mm. In genitalia (figs. 27m-n), sternum IX widely depressed in its caudal margin and ventral membrane extending from it bare; tergum IX subrectangular with reduced, conical AP and a shallow notch caudomedially. Basistyle with a slender ventral root, its dorsal root hardly perceptible; dististyle slender from beginning, ending in a finely pointed tip. Aedeagus stout with very short, slender arms and stem - the stem ending caudad in a finely rounded tip. Parameres (fig. 27m) separated, stem of each tapering into a filiform pointed tip bare throughout.

Distribution: India (Darjeeling town of West Bengal).

Type-data : Holotype female (Type No. Ent. Co 11 PC2M), collected from Govt. College Campus, Darjeeling, on June 2, 1978, by P. P. Choudhuri at light trap; Allotype male collected on September 4, 1978, other data as type; Paratype 12 females, 6 males collected during March - September, 1978, other data as type.

Comments : The present species is however very much different from others of its group in such features as : differential leg and wing colouration, 6 spines in hind tarsal comb the first from spur longest and unequal claws in female mid legs. It is, therefore, taken as a new species and named *E. imperunguis*.

Culicoides waldensig, n.sp.

(Figs. 28a-j)

Female : wing length 1.46 mm, breadth 0.7 mm.

Head - frontovertex (fig. 28a) yellowish with about 14 setae scattered all over. Eyes touching at a point, bare. Antenna (fig. 28b) yellow to yellowish with average lengths of segment III-XV in proportion of 15-14-13-14-13-14-15-15-24-23-25-28-41; AR 1,2; scabella coeloconica on III, XI-XIV and XV ending without forming any nipple-like process. Maxillary palp (fig. 25c) with average lengths of segments I-V in proportion of 8-25-32-16-12; segment III slender, progressively swollen apical to an extent

Fig. 28. Callicoides maldacensis, n.sp.: a-j:

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

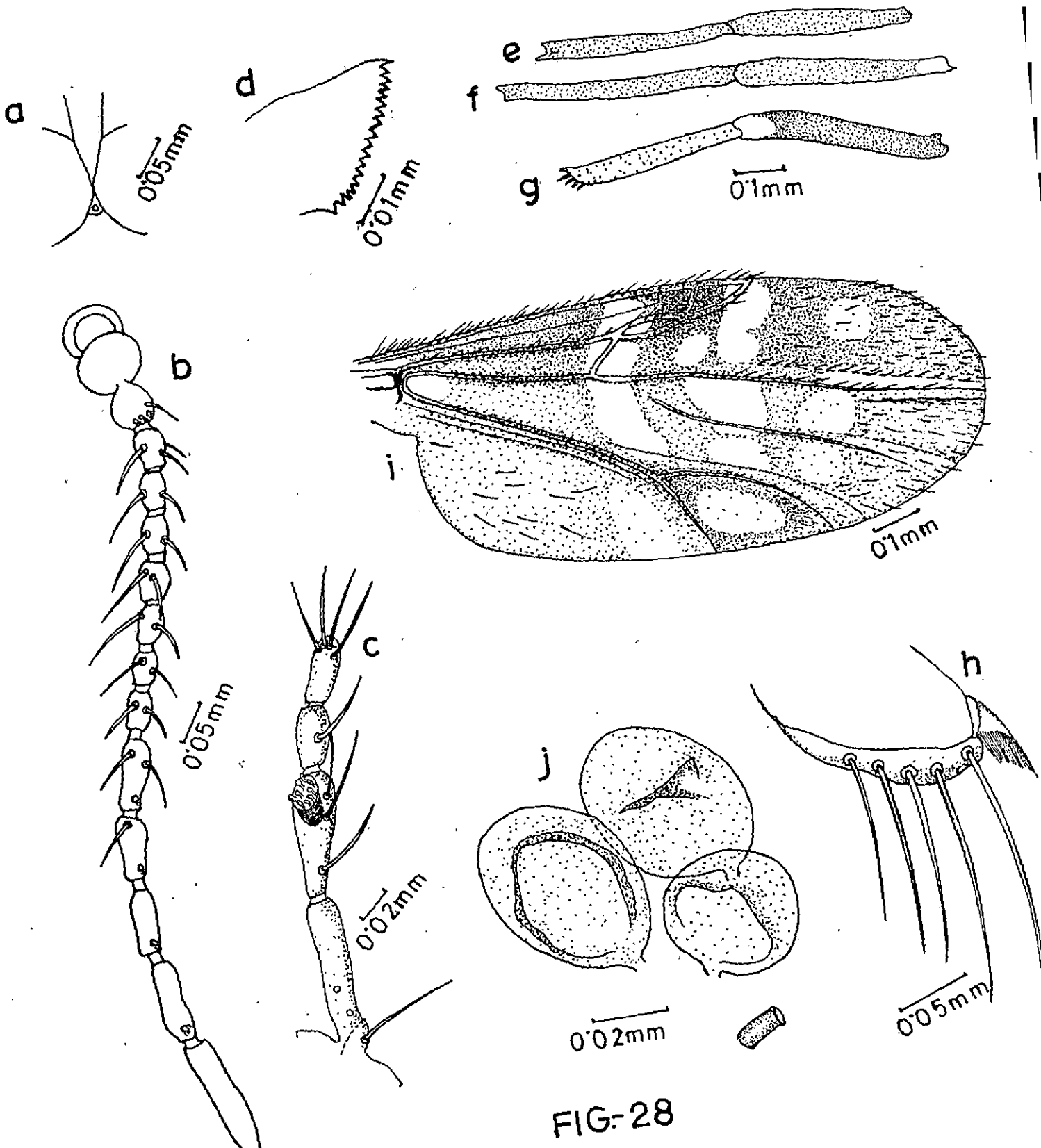


FIG-28

and with a sac-like sensory pit there housing few sensory hairs; L/W ratio 3.2. Proboscis moderately long, P/H ratio 0.87. Mandible (fig. 28d) with about 18 minute, conical teeth.

Thorax: scutum brownish yellow, scutellum with 10 big and 6 small bristles. Legs (figs. 28e-g) brown yellow with narrow pale spot-one at base of mid femora and the other at apex of hind femora; HFC (fig. 28h) of 5, first from spur longest; tarsal ratio of hind legs 1.77; tarsal claws usual in all legs.

Wing (fig. 28 i) - yellowish with distinctly set pale spots as figured : at extreme base, at r-m, at apex and below of second radial cell, at middle and close to margin in cell R_5 , two each in cell M_1 and M_2 , and in cell M_4 anal cell; macrotrichia in a good number in distal part of cell R_5 to cell M_2 with stray few in anal cell; costa extends to 0.61 of wing length. Halteres pale.

Abdomen - brown yellow; with three spermathecae (fig. 28j) unequal, moderately sclerotized and of a subpherical to ovoidal shape measuring 0.056 x 0.048 mm, 0.048 x 0.056 mm and 0.03 x 0.03 mm; spermathecal necks not broadened, sclerotized at beginning; a longish ring visible.

Male : unknown.

Distribution : India (Malda town of West Bengal).

Type-data : Holotype female (Type No. Ent. Cs 12 PGZM), collected from Malda College Campus, Malda, on May 26, 1978, by P. P. Choudhuri at light trap; Paratype 1 female, on March 4, 1978, other data as type.

Comments : The distinctive features of the present species are : characteristic leg and wing colouration, 5 spines in hind tibial comb with the first spine from spur longest, and subspherical to ovoidal spermathecae unequal in size. It is named *G. maldaensis*, after its place of collection, taking it as a new species.

Culicoides pseudoflavescens, n. sp.

(Figs. 29 a-j)

Female : wing length 1.22 (1.1 - 1.3, n = 2) mm, breadth 0.6 mm.

Head - frontovertex (fig. 29a) brownish yellow with about 18 setae scattered all over. Eyes narrowly separated, bare. Antenna (fig. 29b) yellowish and light brown at base of each segment whose average length from III-XV in proportion of 16-11-11-11-12-11-11-13-20-19-20-20-30; AR 1.13; sensilla coeloconica on III, XI-XV and XV ending without forming any nipple-like process. Maxillary palp (fig. 29c) with average lengths of segments I-V in proportion of 7-27-21-14-10; segment III swollen subapical, having there a wide-mouthed, deep sensory pit housing sensory hairs, and then

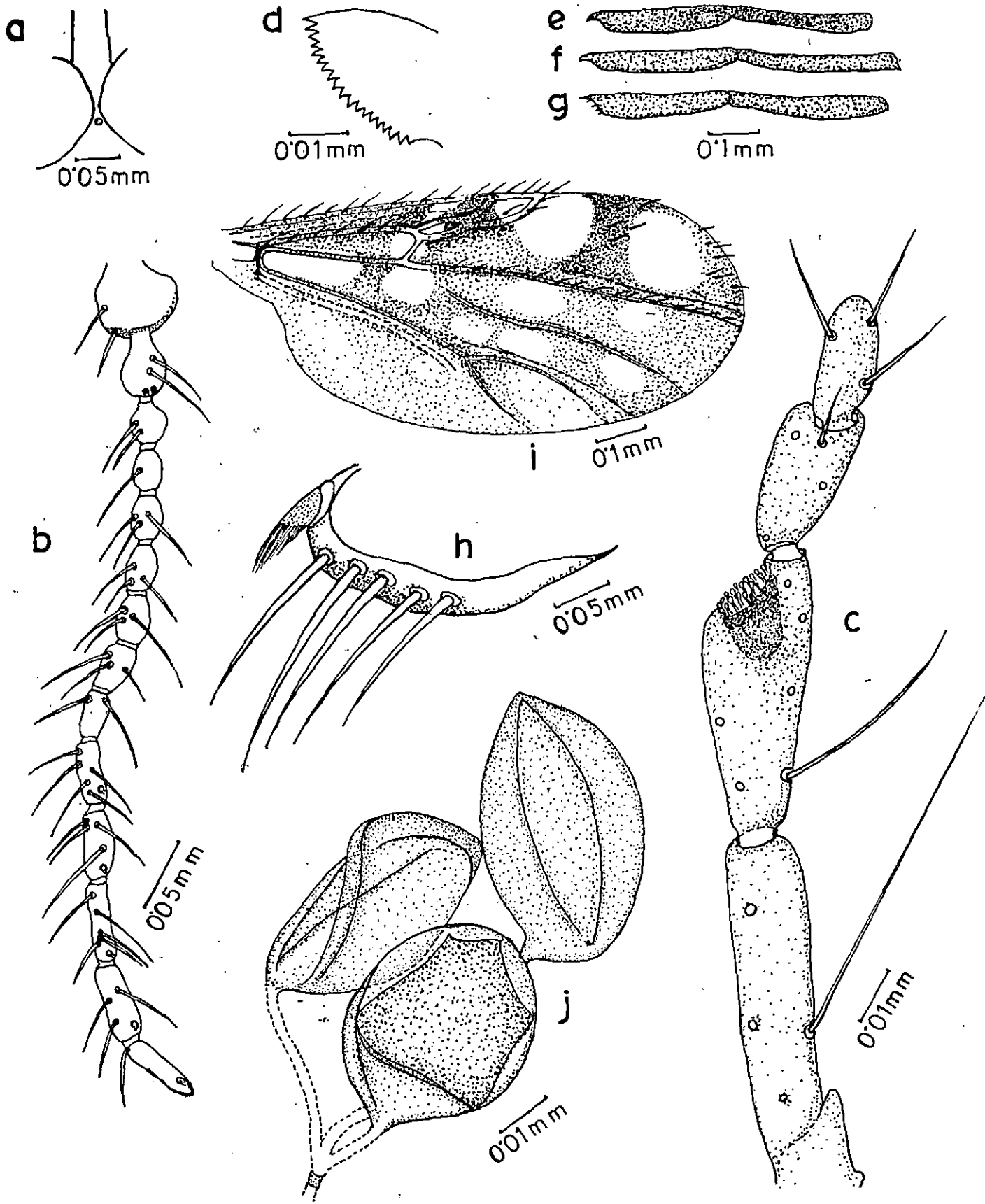


FIG.-29

tapered sharply; L/W ratio 3.00 (2.5 - 3.5, n = 6). Proboscis short, P/H ratio 0.78 (0.72 - 0.8, n = 6). Mandible (fig. 29d) with about 19 minute conical teeth.

Thorax - scutum yellow, scutellum with 12 large and 10 small bristles. Legs (figs. 29 e-g) light brown, one vague pale mark subbasally in fore tibia; HTS (fig. 29h) of 5, second from spur longest; tarsal ratio of hind legs 1.99 (1.9 - 2.1, n = 6); tarsal claws usual in all legs.

Wing (fig. 29i) - yellowish brown with distinctly set pale spots as figured : at base, at r-m, at apical end of second radial cell and at apical margin of cell R_5 , two each in cell M_1 , M_2 and anal cell, and in cell M_3 ; macrotrichia mostly confined to radial vein, its branches and vein M_1 with stray few in cell R_5 ; costa extends to 0.55 of wing length. Haltere knob pale.

Abdomen - yellow brown; with three spermatheca (fig. 29j), moderately sclerotized, somewhat pyriform and subequal measuring respectively 0.05 x 0.04 mm, 0.042 x 0.03 mm and 0.04 x 0.03 mm; spermathecal necks not broadened, just sclerotized at beginning; a narrow ring visible.

Male : unknown.

Distribution : India (Malda town of West Bengal).

Type-data : Holotype female (Type No. Ent. Co 13 PCZM), collected from College Campus, Malda, on September 26, 1978, by P. P. Choudhuri at light trap; Paratype 2 females, same data as type.

Comments : The present species resembles C. flavescens Wirth and Hubert and taking it as a new species, it is named C. pseudo-flavescens. Its distinctive features are : a well-formed sensory pit in third palpal segment, characteristic wing and leg colouration and 5 spines in the hind tibial comb, the second from the apex longest.

Culicoides usitatus, n.sp.

(Figs. 30 a-f)

Female : wing length 1.24 mm, breadth 0.6 mm.

Head - Frontovortex (fig. 30a) light brown with about 12 setae scattered all over. Eyes narrowly separated, bare. Antenna (fig. 30b) brownish yellow with average lengths of segments III-XV in proportion of 16-10-11-12-12-12-13-15-20-21-22-22-34; AR 1.1; sensilla coelocanica on III, XI-XIV and XV ending without forming any nipple-like process. Maxillary palp (fig. 30c) with average lengths of segments I-V in proportion of 10-50-24-11-13; segment III swollen past middle, slender and with a shallow sensory pit apical housing stray sensory hairs; L/W ratio 3.00. Proboscis rather long, P/H ratio 0.92. Mandible (fig. 30d) with about 14 conical teeth directed outward.

Fig. 39. *Culicoides unctatus*, n. sp.: a-j.

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

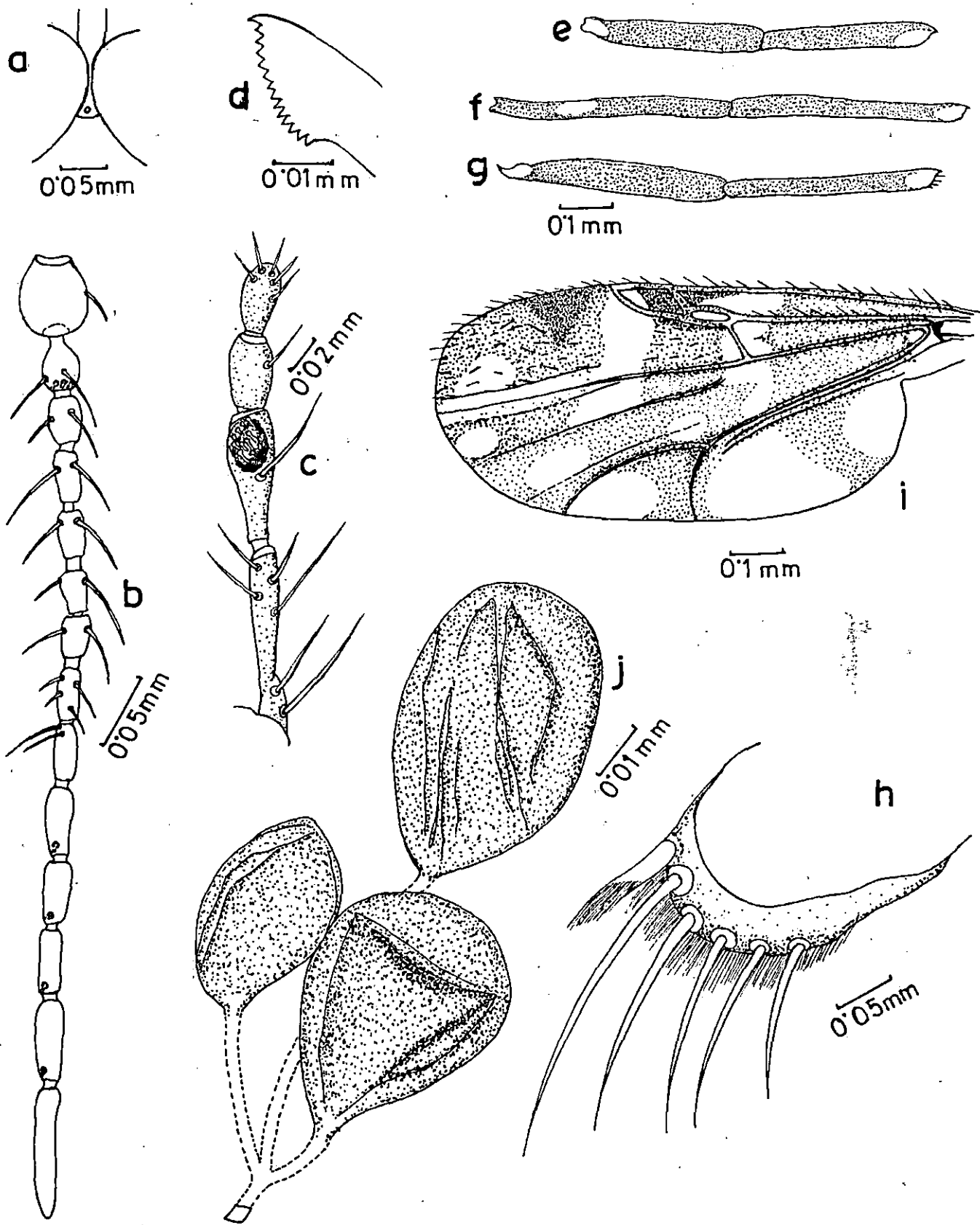


FIG-30

Thorax - scutum yellow brown, scutellum with several bristles of varying lengths. Legs (figs. 30e-g) light brown with bases of femora and apices of tibiae vaguely pale; mid femora with subbasal pale band and hind tibia with apical pale band; HTC (fig. 30 h) of 5, first from spur longest; tarsal ratio of hind legs 1.8; tarsal claws usual in all legs.

Wing (fig. 30 i) - yellowish with distinctly set pale spots as figured : at extreme base, at r-m and apical half of second radial cell, in cell R_5 near apical margin, two each in cell M_1 , M_2 and anal cell while cell M_4 bears one marginal pale spot; macrotrichia in a good in cell R_5 ; costa extends to 0.58 of wing length. Haltere pale.

Abdomen - yellow brown; with three spermathecae (fig. 30j) pyriform, moderately sclerotized and of a varying size measuring 0.048×0.032 mm, 0.042×0.032 mm and 0.034×0.024 mm; spermathecal necks not broadened, sclerotized at beginning; a narrow ring visible.

Male : unknown.

Distribution : India (Darjeeling town of West Bengal).

Type data: Holotype female (Type No. Ent. Cs 14 FC2M), collected from Govt. College Campus, Darjeeling, on June 2, 1978, by P.P. Choudhuri at light trap; Paratype 2 females, data same as type.

Comments : The present species resembles G. pseudoflavescens, described now from Darjeeling, but its distinctiveness are : characteristic leg and wing colouration, lesser number of mandibular teeth, hind tibial comb of 9 spines with the first from spur longest and pyriform spermathecae. It is essentially a common place Gulicoides and is named G. ucitatus, taking it as a new species.

D) RARI PALPIS GROUP OF SPECIES

Gulicoides clausus, n.sp.

(Figs. 31a-n)

Female : Wing length 1.07 mm, breadth 0.54 mm.

Head : frontovertex (Fig. 31a) dark brown with about 7 setae scattered all over. Eyes broadly contiguous, bare. Antenna (fig. 31b) brown with average lengths of segments III-XV in proportion of 20-15-15-15-15-15-15-21-20-24-26-40; AR 1.04; scencilla cocloconica on III, XI-XIV. Maxillary palp (fig. 31c) with average lengths of segments I-V in proportion of 7-15-18-9-9; segment III rather slender, just swollen subapically with stray sensoria and no sensory pit visible; L/W ratio 2.71. Proboscis moderately long, P/H ratio 1.59. Mandible (fig. 31d) with 9 teeth, basal few thicker and all directed outward.

Fig. 31. Culicoides slavus, n.sp. | a-n:

Female - a, frontovertex; b, antennae;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

Male - k, wing; l, genitalia (aedeagus
and parameres removed); m, aedeagus;
n, parameres.

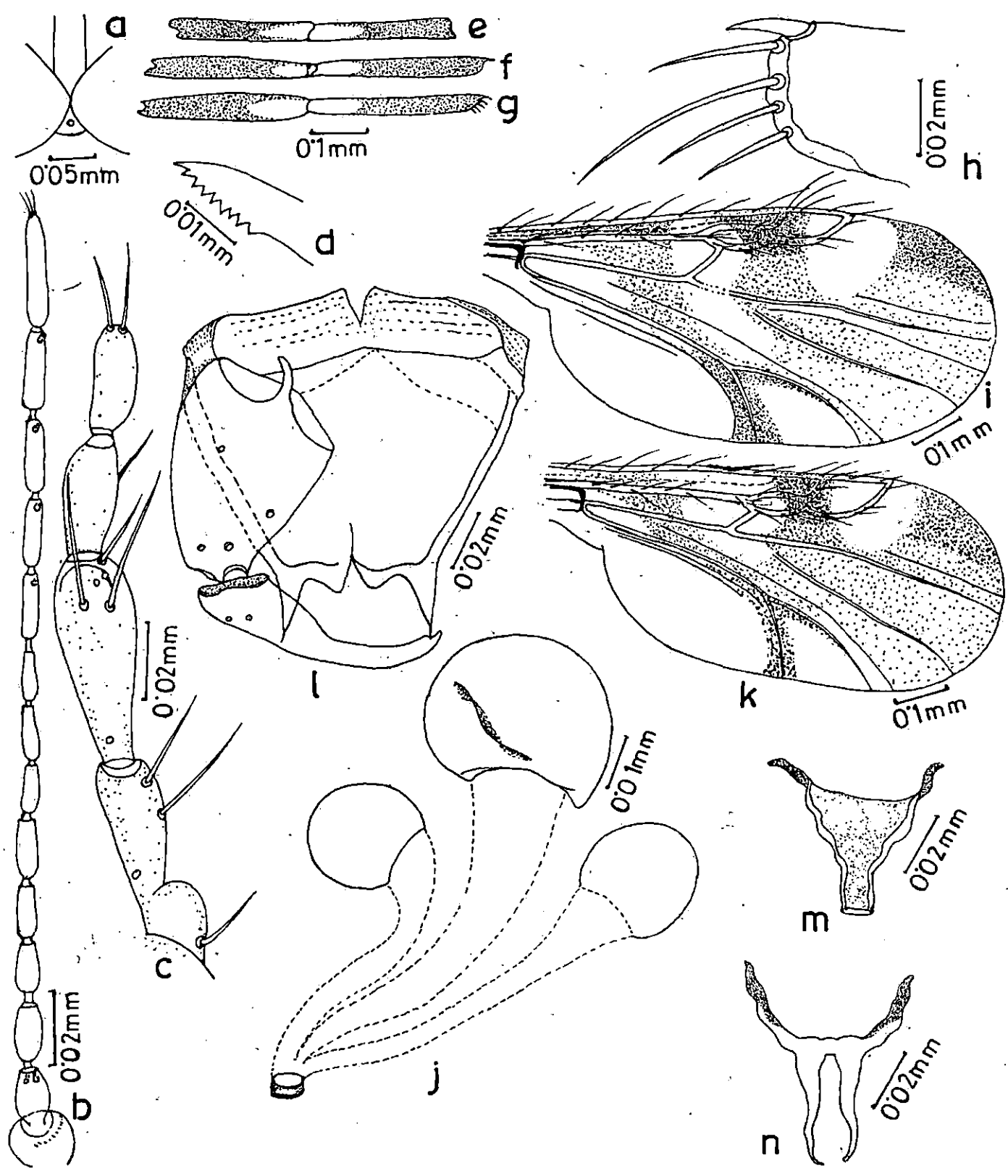


FIG.-31

Thorax - yellowish brown; scutum darker, unicolourous.
 Legs (figs. 31 e-g) dark brown with broad subapical/apical pale spots on femora and similar subbasal/basal spots on tibiae; HTC (fig. 31 h) of 4, second from spur longest; tarsal ratio of hind leg 2.18; tarsal claws usual in all legs.

Wing (fig. 31 i) - pale brown with extensive paler areas, the colour-pattern such as to impress pale wing with stray blotched spots/streaks as : at base of costal cell, covering part of first and second radial cells, at apical angle of wing in cell R_5 and along vein Cu_1 ; macrotrichia scanty; costa extending to 0.68 of wing length. Haltere totally pale, creamy in fresh state.

Abdomen - brown; spermathecae (fig. 31 j) three, like those of C. albibasis, broader than long; somewhat hemispherical in outline, they measure 0.020 x 0.025 mm, 0.02 x 0.018 mm and 0.019 x 0.017 mm with their very broad necks unsclerotized from beginning; a narrow ring visible.

Male : wing (fig. 31 k) measures 0.86 x 0.41 mm., In genitalia (fig. 31 l-n), sternum IX almost flat caudad and ventral membrane extending from it bare; tergum IX with a deep caudomedial notch flanked by stiff, acuminate AP. Basistyle with no perceptible ventral root but its dorsal root slender, long; dististyle incurved past middle and attenuates to a finely hooked tip.

Aedeagus (fig. 31 m) massive with prominent arms and apex, apex-tip blunt and flat. Parameres (fig. 31 n) separated excepting apparently for extreme base, each having a filiform caudal end tapering to a simple point.

Distribution : India (some parts of 24-Parganas district of West Bengal).

Type data : Holotype female (Type no. Ent. Cs 19 PCZW), collected at Habra, on June 12, 1968 by S. K. Dasgupta at light trap; Allotype male, collected on June 16, 1968 other data as type; Paratype 9 females and 2 males, collected between June 12-16, 1968, other data as type.

Comments : The present species has some unusual features : broadly separated eyes, pale wings with 3 or 4 darkish spots/areas, hemispherical type spermathecae with very broad, unsclerotized necks and parameres showing a trace of fusion band as figured for C. elbetti by Wirth and Hubert (1959). For its very limited wing-blotchings, its wings in pinned state appear pale clear; so it is named as C. clarus, taking it as a new species of subgenus Trithocoides. It has 9 mandibular teeth of which the basal few are thicker and in its hind legs, the spur-tip is conical and never frayed. Thus, for a somewhat odd character-

combination, the group-placement of G. glorus looks difficult and for the present, it is suggested that it be included under the more heterogeneous group, the Baripalpis Group, under subgenus Trithacoidea.

Culicoides flavicinctatus Wirth and Hubert

Culicoides flavicinctatus Wirth and Hubert, 1959 : 54.-

Lee, 1979: 98.- 107 (record ex Tibet).

Culicoides anophelia Edwards (in part - misidentif.),

1922: 161; Macfie, 1932: 493.

Culicoides varipalpis, (misidentif., not Smith) Macfie,

1937 : 115.

Female : wing length 0.86 mm, breadth 0.52 mm.

Head - frontovertex brown. Eyes broadly touching, bare.

Antenna with average lengths of segments III - XV in proportion of 17-14-15-16-16-15-15-15-21-20-23-23-38; AR 1.01; sensilla coelocornica on III, XI - XV and XV ending in a nipple-like process.

Maxillary palp with average lengths of segments I-V in proportion of 3-12-14-5-5; segment III slender, longer than maximum width with stray sensory hairs in distal half; L/W ratio 1.6 (1.5 - 1.7, n=3)

Maxillary blade with 13 (n = 3) small, subequal teeth in a row.

Mandible with 12 (11-13, n = 3) small, conical and subequal teeth.

Thorax - scutum and upper half of pleuron pale yellow; scutellum, postscutellum and rest of pleuron dark brown; 3 stout bristles in scutellum. Legs dark brown; pale bands subapical on fore femora, broad and subbasal on fore tibiae, apical on mid femora and hind tibiae, and basal on mid and hind tibiae with hind femora all dark; HFC of 4, second from spur longest; tarsal ratio of hind leg 2.2; tarsal claws simple.

Wing - brown with pale spots as : at base and the same extending to anal cell having one more pale spot just behind vein Cu_1 , at $r-m$, two pale spots in cell R_5 - one proximal in the cell extending to the second radial cell and the other continued apically down to vein M_2 , and one each in cell M_2 , M_4 and at middle of vein M_2 - that at vein M_2 extending to cell M_1 and M_2 while that at cell M_2 confluent with a linear pale streak; macrotrichia scanty, a stray few distally in cell R_5 , M_1 and M_2 ; costa extends to 0.64 of wing length. Haltere pale.

Abdomen - light brown and tergal sclerotization not very strong. Spermathecae three with wide, unclerotized necks, the larger spermatheca measuring 0.052×0.026 mm while the other two equal to subequal measuring on average 0.018×0.015 mm; ring visible.

Male : wing measures 0.78×0.23 mm.

In genitalia, sternum IX flat, without any caudomedial depression; tergum IX long and tapering caudad with a deep caudo-medial cleft flanked by two sizeable sublateral lobes and prominent AP. Basistyle with ventral root not apparent and dorsal root slender; dististyle incurved at middle ending in a pointed tip. Aedeagus with arms and stem prominent, the caudal end of stem blunt, flat. Parameres separated, caudal half of each thick at base but then tapering caudad to a simple, filiform tip bent ventrolaterad.

Distribution : North Borneo; India, Malaya, Philippines, Sarawak, Sri Lanka, Sumatra, Thailand and Tibet.

Specimens examined : INDIAN FORMS : 4 females from Siliguri College Campus, Siliguri, at light trap during May 1978 by P. P. Choudhary and S. K. Dasgupta. EXOTIC FORMS - 2 Paratype females, 1 Paratype male collected during September - November 1948 from Labuan Is., North Borneo around light; also 1 female from Thailand collected on September 30, 1954, at light - all in slide-mounts and received from W.W. Wirth.

Comments : The similar mandibular teeth, totally pale scutum, pale halteres and undepressed and flat caudal margin of sternum IX of male genitalia are some of the characterizing features of the present species which were missed by some of the previous workers who relegated therefore, by mistake, their samples of

flaviscutatus to other related species. It appears that the present species has a rather wide distribution in nature.

The Indian records of the present species may be listed as follows : Dharwar (Maharashtra State), Gauhati (Assam) and Siliguri (West Bengal); the first two localities are reported by Wirth and Hubert (1959).

Gulicoides infrequens, n.sp.

(Figs. 32 a-n)

Female : wing length 1.08 mm, breadth 0.52 mm.

Head - frontovortex (fig. 32a) dark brown with about 8 setae scattered all over. Eyes contiguous, bare. Antenna (fig. 32b) brown with average lengths of segments III-XV in proportion of 19-15-15-15-16-16-16-16-21-21-21-22-39; AR 0.96; scabella coeloconica on III, XI - XIV. Maxillary palp (fig. 32c) with average lengths of segments I-V in proportion of 6-21-23-10-9; segment III quite swollen at and beyond middle with vaguely marked, subelliptical sensory pit bearing sensory hairs; L/W ratio 2.7. Proboscis long, P/H ratio 1.83. Mandible (fig. 32d) with 11 subequal teeth, directed outward.

Thorax - dark brown; mesonotum unicolourous with setose hairs. Legs (figs. 32 e-g) brown with a narrow pale marking at apex of all femora, the tibiae being totally dark; MTC (fig. 32 h) of 4, first from apex longest; tarsal ratio of hind legs 2.4; tarsal

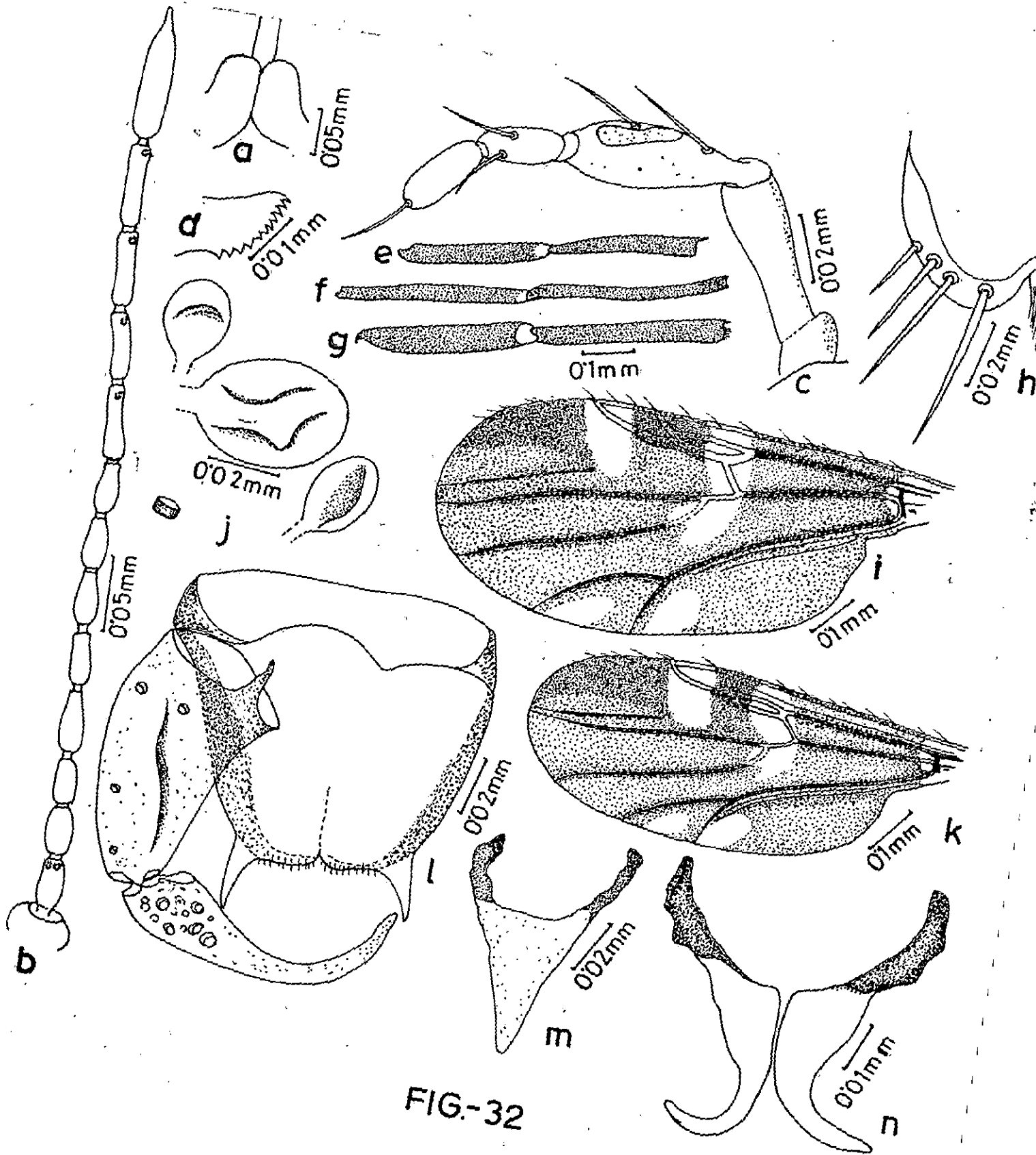


FIG.-32

tarsal claws usual in all legs.

Wing (fig. 32 i) - mostly dark, brown to dark brown and pale spots as : at base, at r-m and extending upwards to costa and below past the base of vein M_2 , at cell M_1 , touching wing margin and at anal cell just behind the distal part of vein Cu_1 ; stray macrotrichia close to costal margin; costa extending to 0.74 of wing length. Haltere knob light brown.

Abdomen - dark brown; with three spermathecae (fig. 32 j) ovoidal, the larger one measuring 0.032×0.026 mm and the smaller two subequal and measuring 0.02×0.012 mm and 0.016×0.014 mm; spermathecal necks narrow, unc sclerotized at beginning and a narrow ring visible.

Male : wing (fig. 32 k) measures 0.68×0.42 mm.

In genitalia (fig. 32 l-n), sternum IX with a fairly deep caudomedial excavation and ventral membrane extending from it bare; tergum IX subrectangular with a cleft at the middle of its caudal margin and two prominent AP directed caudad. Basistyle with well-formed dorsal root but ventral root imperceptible; dististyle strongly incurved past middle and tapering to a blunt, slender tip. Aedeagus (fig. 32 m) with slender, longish arms with stem not perceptibly marked off from the base and the whole forming a stout, conical piece with narrowed, blunt caudal tip. Parameres (fig. 32 n)

separated, each a stout piece subconical in outline at base with caudal half as a slender, outcurved structure ending in a simple, blunt point.

Distribution : India (Habra area of 24 Parganas district, West Bengal).

Type-data : Holotype female (Type No. Ent. Co 16 PCZM), collected at College Campus, Habra, on April 8, 1980, by P. P. Chowdhuri at light trap; Allotype male, collected on June 22, 1980, other data same as holotype; Paratype 4 females and 1 male, female data as holotype male data as allotype.

Comments : The present species is, however, very distinctive in several aspects of male genitalia - stem and body of aedeagus forming a conical structure, massive paramere body with caudal half as a slender piece ending to a blunt caudal point, fairly deep caudomedial excavation in sternum IX and strongly incurved distal half of dististyle. It is another species of Trithesoides that shows, in the apical row of hind tarsal comb, the first spine from the spur longest. Its characteristic wing and leg colouration alongwith extended contiguity of eye margins are other noteworthy features and force to admit it as a new species that is named as G. infrequens.

Gulicoides nullus, n.sp.

(Figs. 33 a-j)

Female : wing length 1.2 mm, breadth 0.6 mm.

Head - frontovertex (fig. 33a) brown with about 24 setae scattered all over. Eyes contiguous, bare. Antenna (fig. 33b) brownish with average lengths of segments III-XV in proportion of 18-16-16-17-17-17-17-21-21-23-26-36; AR 0.95; sensilla coeloconica on III, XI-XIV. Maxillary palp (fig. 33c) with average lengths of segments I-V in proportion of 6-20-22-12-11; segment III just inflated past middle but quite long and slender with no visible trace of any sensory hair or sensory pit on its surfaces; L/W ratio 3.14. Proboscis moderately long, P/H ratio 1.6. Mandible (fig. 33d) with 11 prominent teeth, slightly incurved and basalk few thicker.

Thorax - yellowish brown; scutum and postscutellum yellowish brown to dark brown, unicolourous. Legs (figs. 33 e-g) brown to brownish with both ends of fore and mid femora and fore and hind tibia either narrowly or broadly pale; hind femora totally dark and mid tibia also so save for the narrow pale spot at base; HTC (fig. 33h) of 4, second from spur longest and spur-tip frayed with a stout dorsal spine; tarsal ratio of hind leg 1.83; tarsal claws usual in all legs.

Wing (fig. 33 i) - yellowish brown with at least 6 vaguely marked pale areas as : at r-m (not touching costal margin), at tip

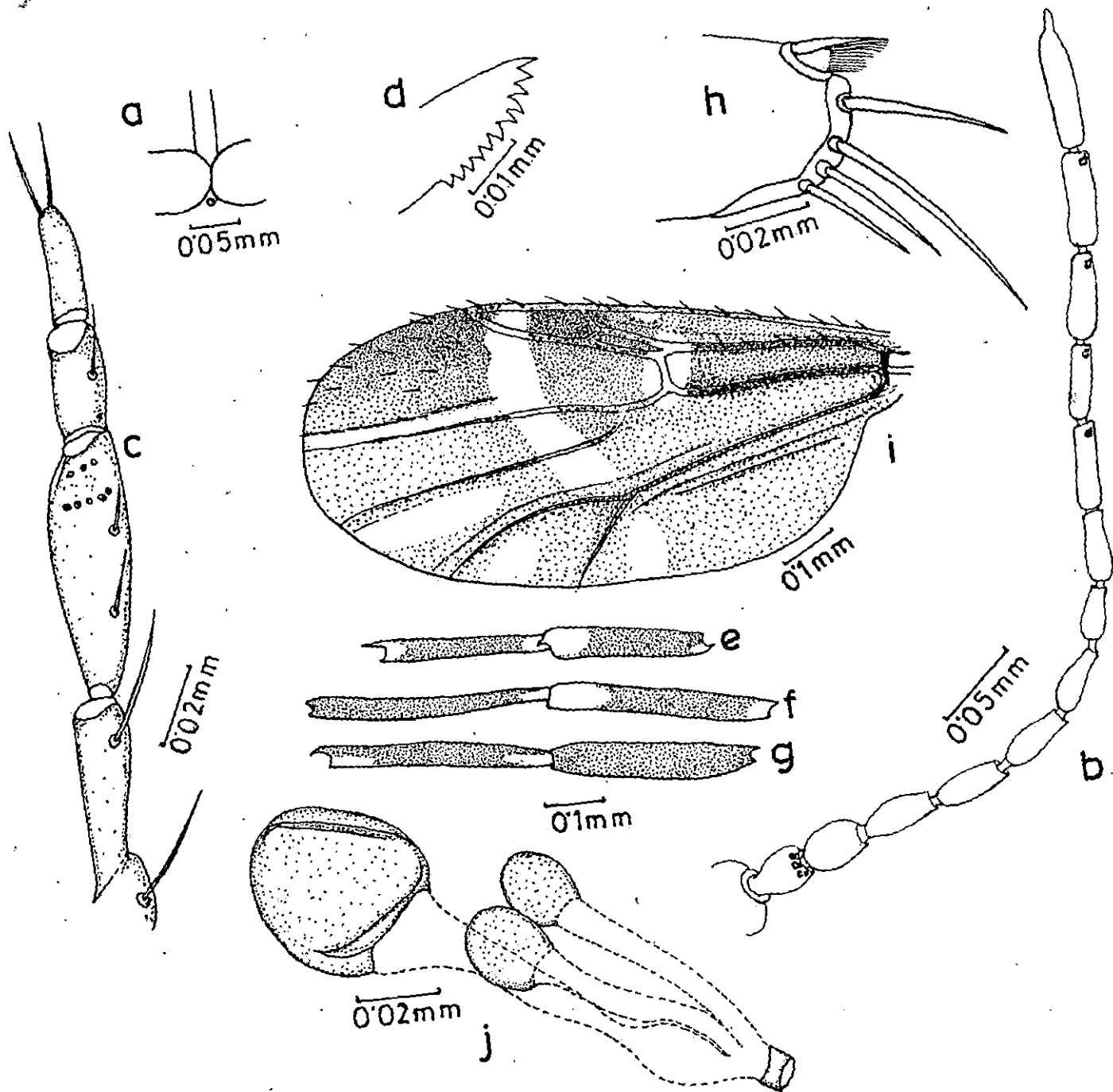


FIG.-33

of second radial cell extending down across cell R_5 , M_1 and M_2 as an oblique pale column, each at cell M_2 , M_4 and anal cell, and an additional pale streak in cell R_5 touching vein M_1 ; macrotrichia scanty, in cell R_5 only; costa extending to 0.66 of wing length. Haltere pale brown.

Abdomen - dark brown; with three ovoidal spermathecae (fig. 33 f), longer than broad and the larger one measuring 0.032 x 0.03 mm while the other two are subequal and measuring 0.016 x 0.012 mm and 0.012 x 0.012 mm; spermathecal necks and unscerotized and quite broad at the beginning; a narrow ring visible.

Male : unknown.

Distribution : India (Darjeeling town of West Bengal).

Type-data : Holotype female (Type No. Ent. Cs 17 PCZM), collected at Govt. College Campus, Darjeeling, in June 1978, by P. P. Choudhuri at light trap.

Comments : The present species is named G. nullus in view of the wing pallor that appears mostly darkish and for this unusual peculiarity, it is now described as a new species even though basing only on holotype. It belongs to the Raripalpis Group of subgenus Trithecoides as it has similar mandibular tooth-pattern and spermathecal compliments.

Culicoides varinalis Smith

Culicoides varinalis Smith, 1929: 256 (female, Assam; biting man).- Macfie, 1937: 469 (Malaya, notes).- Causey, 1938: 409 (Thailand, notes both sexes).- Wirth and Hubert, 1959: 29 (redescription records).

Female : wing length 0.81 mm, breadth 0.43 mm.

Head - frontovertex brown. Eyes broadly contiguous, bare. Antenna with average lengths of segments III-XV in proportion of 18-12-12-15-11-11-11-11-15-20-21-24-26 and segment XV ending in well shaped nipple like process; AR 1.05; ocellia cocleconica on III, XI - XV (in Calcutta suburb's material), III, XII-XV (in Sikkim material) and on III, XI, XIII-XV (in Malayan form). Maxillary palp with segment III as long as or longer than II, just swollen past middle and having subapically stray sensory hairs (in single Malayan form examined, III segment short and stout as long as its maximum breadth). Mandible with 11 subequal small teeth directed outward.

Thorax - scutum pale, yellowish in front (Indian and Malayan form) but dark brown (in Thailand form); other areas dark brown without any exception and 5 scutellar bristles visible. Legs dark brown with apical-subapical/basal - subbasal pale spot/s in all femora and tibiae excepting hind femora shaded throughout; HTC of 4, second from spur longest; tarsal ratio of hind legs 1.86;

tarsal claws usual in all legs.

Wing - dark brown with distinctly set pale spots at extreme base, at r-m and over apical half of second radial cell; apex of wing and other wing cell surfaces not pale; macrotrichia scanty, stray few in cell R_5 and M_1 ; Haltere dark.

Abdomen - dark brown; with three spermathecae pyriform, unequal and measuring 0.054×0.03 mm, 0.027×0.023 mm and 0.023×0.02 mm; spermathecal necks just broadened but unsclerotized at beginning; a narrow ring visible.

Male : wing measured 0.7×0.34 mm. In genitalia, sternum IX with a very shallow caudomedial depression; tergum IX with a small caudomedial notch and prominent AP; dististyle incurved at distal third with slender, pointed tip. Aedeagus with arms and stem slender, of a moderate length and stem ending in a flat, blunt tip. Parameres separated, each produced caudad to a slender, tapering process ending in simple, bare, outcurved tip.

Distribution : India; Malaya and Thailand.

Specimens examined : INDIAN FORMS: 4 females collected from Belgatchia (Calcutta) as also 5 females and 2 males from Nayabazar West Sikkim, during March 1958-September 1960, at light trap (Sikkim material by Dr. U. K. Banik; Belgatchia material by

S. K. Dasgupta), all at light trap. EXOTIC FORMS : 1 female, collected from Malaya in July 1958 at light trap (donated by Dr. W. Wirth).

Comments : Some instances of misidentification assigning material of other species to the present species were pointed out by Wirth and Hubert (1959). The Indian forms examined now agreed in basic features of G. raripalpis and so we were certain that G. raripalpis was not actually limited in distribution. The speciality of the Indian forms was that the third palpal segment was rather slim, very much longer than broad and not as long as broad and short as reported in case of the raripalpis specimens from outside India. The occurrence of sensilla coeloconica on female antennomeres III, XI-XV of Calcutta specimens was another noteworthy feature.

The Indian records of G. raripalpis to the date are : Burnihat area of Assam (Smith, 1929), Calcutta (Dasgupta, 1959-1964) and Nayabazar, West Sikkim (Dasgupta, 1963).

Gulicoides circularis, n.sp.

(Figs. 34 a-j)

Female : wing length 1.1 mm, breadth 0.56 mm.

Head - frontovortex (fig. 34a) brownish yellow with about 16 setae scattered all over. Eyes contiguous, bare. Antenna (fig. 34b) yellowish with average lengths of segments III-XV in

Fig. 34. Culicoides singularis, n.sp.; a-j:

Female - a, frontovertex; b, antenna;
c, maxillary palp; d, mandible;
e-g, legs; h, hind tibial comb;
i, wing; j, spermathecae.

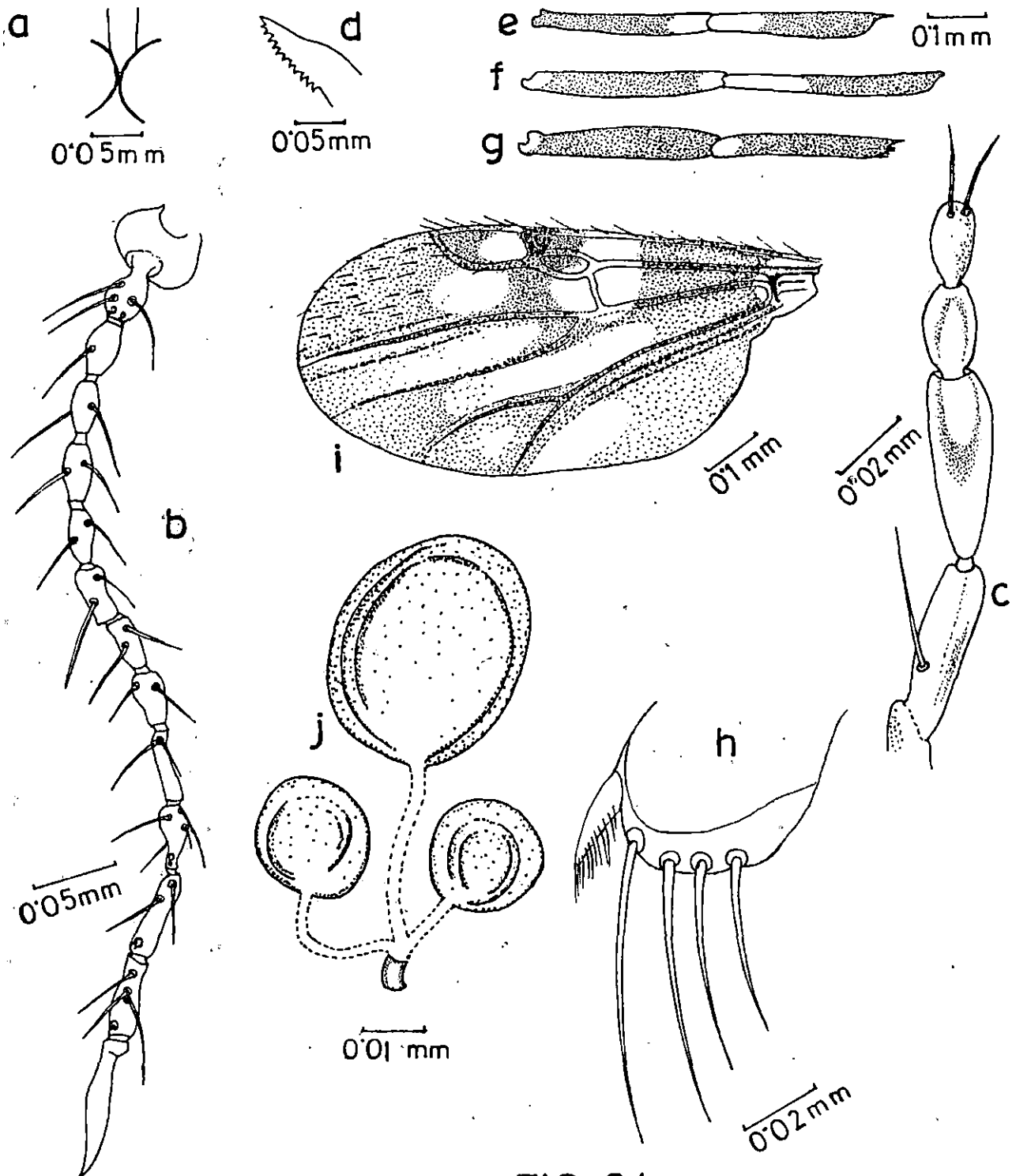


FIG.-34

proportion of 15-16-17-19-18-19-17-17-24-20-24-25-41; AR 0.97; sensilla coeloconica on III, XII-XIV. Maxillary palp (fig. 34c) with average lengths of segments I-V in proportion of 5-20-21-10-9 segment III quite long, slender with a feebly marked sensory pit-like area distally wherein the sensory hairs of the segment are located; L/W ratio 3.00. Proboscis moderately long, P/H ratio 1.33. Mandible (fig. 34d) with 12 minute, conical teeth on average which are directed outward.

Thorax - yellow; scutum yellowish with prominent vittae scutellum with 12 bristles - median 2 and lateral 2 large while sublateral 6 and extreme lateral 2 small. Legs (figs. 34 e-g) pale yellow with pale areas as figured; HPC (fig. 34h) of 4, first from spur longest; tarsal ratio of hind leg 2.4; tarsal claws usual in all legs.

Wing (fig. 34 i) - yellow to yellowish, with isolated pale spots as figured; pale area at wing base encroaching proximal portion of all trunk veins and extending to the anal cell; pale spot over $r-m$ continued anteriorly to costal margin and to cell M_2 caudad; a very small, dark spot anteriorly over vein R_1 , cell R_5 without any pale spot/area in its apical half; second radial cell comparatively large with one roundish pale spot at its proximal half, cell M_1 with an elongate oval pale spot touching

the vein M_2 in the middle, cell M_2 with one large pale spot overlying the mediocubital fork, cell M_4 with a small, suboval pale spot and anal cell having one elongate, large pale spot touching broadly the wing margin; vein M_1 straddled by feeble pale streak; macrotrichia scanty; costa extending to 0.69 of wing length. Haltere stem and base of the knob infuscated, otherwise yellowish, pale.

Abdomen - yellowish brown. Spermathecae (fig. 34 j) three, subglobular to slightly elongate, with un sclerotized, narrow necks the larger spermatheca measuring 0.039 x 0.028 mm, the other two subequal and measuring 0.018 x 0.018 mm and 0.016 x 0.016 mm; ring prominently visible.

Male : unknown.

Distribution : India (Darjeeling town of West Bengal).

Type-data : Holotype female (Type no. Ent. Co 18 PCZM), collected at Govt. College Campus, Darjeeling, on June 10, 1978, by P. P. Choudhuri at light trap; Paratype 5 females, same data as type.

Comments : The present species is C. singularis in view of such peculiar features as : long, slender III segment of the maxillary palp, yellowish scutum with vittae of dark brown shade, pale area covering second radial cell and cell E_5 not as one contiguous pale spot rather as two disparate, roundish spots

confluencing at vein R_{4+5} and the larger spermatheca at least 2 times bigger than the other two spermathecae. In having no paleness at wing apex and in a few other features, *G. singularis* resembles *G. varipennis* Smith, extant in the plains of eastern India. But it stands out readily by its peculiarities stated above and therefore, its present relegation as a new species seems justified.

KEY TO WEST BENGAL SPECIES OF SUBGENUS TRITHECOLDES

1. Mandibular teeth in female numbering upto 18 or less; aedeagal stem somewhat thick, its caudal tip bluntly rounded or truncate and flat 2 (Anopheles Macfieii and varipennis Group)
2. Mandibular teeth in female numbering 19 or more; aedeagal stem slender, its caudal tip finely rounded and never truncate and flat 16 (flavescens Group)
2. Tergum IX with a pair of submedian lobes in caudal margin between apico-lateral processes; mandibular teeth in female 8-15, strongly incurved; spermathecae subapical, equal or subequal with narrow necks 3 (Anopheles Group)

-
- Tergum IX without or with hardly perceptible submedian lobes in caudal margin between apicolateral processes; mandibular teeth not more than 7, incurved; spermathecae unequal with broad necks, the large one as broad as long 4 (Macfiei Group)

 - Tergum IX with a pair of submedian lobes in caudal margin between apicolateral processes; mandibular teeth 11-16 (as in Anophelis Group), directed outward; spermathecae unequal with broad necks, the larger one longer than broad 12 (Narinalpis Group)

 - 3. Mandibular teeth in female about 15; tarsal claws bifid at tip though equal-sized and empodium hairy C. anophelis

 - Mandibular teeth in female about 8; tarsal claws in female never bifid at tip though in midlegs, claws unequal and empodium smooth spine-like C. insolens

4. Wing extensively pale, shading restricted in the form of 3 bands stretching from costa to analt margin; second radial cell very large, costa extending to distal fourth of wing length C. mirus
- . Wing colour and second radial cell otherwise; costa extending to distal third of wing length 5
5. Paleness at wing base and in cell M_1 and M_2 extensive, the cell areas appearing almost totally pale; hind tibia totally pale C. cussinalifer
- . Paleness in parts as above otherwise, not very extensive 6
6. Caudal tip of aedeagal stem of male genitalia bifid; cell M_1 and M_2 in wing apparently without a paleness, shaded almost throughout C. rarisentalis
- . Caudal tip of aedeagal stem of male genitalia never bifid; colouration of cell M_1 and M_2 in wing not as above 7

7. Dark spots/shading in wing confined to its area upper to the level of media and its first branch; third palpomere without a perceptible sensory pit, the sensory hairs scattered or in an ill-defined sensory pit in the segment 8
8. Wing shading not as above; third palpomere with a perceptible sensory pit, the sensory hairs located in the pit 9
8. Third palpomere highly inflated at middle and beyond with a preapical ill-defined sensory pit housing its sensory hairs C. neopelpifer
9. Third palpomere gradually swollen from base, to a slight extent, and its sensory hairs are scattered, without forming any sensory pit C. subnervifer
9. Thoracic scutum shining yellow C. palnifer
10. Thoracic scutum brown to dark brown 10
10. Thoracic scutum dark brown, scutellum and postscutellum concolorous with it; caudal tip of parameres filiform, bare C. macflei

- Thoracic scutum brown, scutellum and post-scutellum pale at middle though concolourous with it; caudal tip of parameres filiform with a few spines 11
- 11. Darkish vittae apparent in thoracic scutum; third palpomere shorter than second palpomere; aedeagal stem abruptly demarcated at base, short and its caudal tip flat, blunt C. parabalnifer
- Darkish vittae not apparent in thoracic scutum; aedeagal stem gently arising from aedeagal body, longish and with finely rounded caudal tip..... C. pseudopalnifer
- 12. Mandibular teeth 9; spermathecae very broad, almost hemispherical in outline with equally broad spermathecal necks; parameres not totally separated C. clarus
- Mandibular teeth 11-12; spermathecae broad but not as above; parameres totally separated 13
- 13. Hind tibial comb of 4 spines, the first from spur longest C. infraquena
- Hind tibial comb of 4 spines, the second from spur longest 14

14. Thoracic scutum with darkish vittae; wing darkish with several small pale spots ... C. nilius
- Thoracic scutum unicolourous, without any vittae; wing slight-shaded with larger pale areas 15
15. Wing apex at least narrowly pale; haltere entirely pale C. flavicutatus
- Wing apex dark, without any speck of paleness; haltere entirely dark C. raxinolpis
- Wing apex dark, without any speck of paleness; haltere stem and knob-base dark, otherwise pale C. singularis
16. Hind tibial comb of 6 spines; tarsal claws in mid legs of female visibly unequal ... C. imparunguis
- Hind tibial comb of 5 spines; tarsal claws equal in all legs 17
17. Second spine from spur, in hind tibial comb, longest C. valdaensis
- First spine from spur, in hind tibial comb, longest 18
18. Thoracic scutum yellow; female frontovertex with about 16 setae; legs light brown with vague subbasal pale mark in fore tibia only.. C. pseudoflavescens
- Thoracic scutum yellow brown; female frontovertex with about 12 setae. Legs light brown with bases of femora and apices of tibiae vaguely pale C. usitatus

IV. SUMMARY : SYSTEMATIC ARRANGEMENT
OF CULICOIDES SPP., OF WEST BENGAL

**SUMMARY: SYSTEMATIC ARRANGEMENT
OF CULICOIDES SPP., OF WEST
BENGAL.**

1. The 79 species of Culicoides, admitted in the present thesis as extant in the State of West Bengal, India, are alphabetically arranged in table 5, showing the species groups and subgenera to which those species belonged. The districtwise occurrence of the species, with indications if those concomitantly were distributed in other parts of India and in countries outside India alongwith sexes those were known, were also stated in the table.
2. It follows from the table that of the 79 West Bengal species, 18 species are described in the present thesis as new to science while of the remaining 61 species, 26 species were described by Majumdar and Dasgupta (1972) and those being yet known only by their manuscript descriptions (op. cit.), those were shown in the present species as new species accruing to the credit of those authors. The remaining 35 species are described previously by various authors as (no. of species described shown in parentheses after author's/ s' name): Arakawa (1), Carter et al. (1), Causey (3), Chu (2), Dasgupta and his other collaborators (13), Edwards (1), Kieffer (8), Mukerji (1), Smith and his collaborator (3),

and Wirth and Hubert (2). Another scrutiny reveals that of 79 species thus known, 54 species are described in both sexes, 20 species only in females and 5 species only in males. Again, species (18) described in only one sex in recent times are provided with enough descriptive points together with due illustrations of their morphology whereas those of earlier years (7) are not so; types of the recent times are also available for comparison whereas the types of the earlier times are not. An immediate contention, therefore can be that of the 79 West Bengal species, only 7 known species may pose difficulty in their recognition and re-collection from nature whereas the other species, the overwhelming majority, are not likely to pose a difficulty in the recognition and re-collection in future studies.

3. The allocation of 79 Culicoides species of West Bengal to species groups and subgenera are now done on a comprehensive basis, a summary position of the allocation being (subgenus name, no. of species in the subgenus/no. of species groups): Avaritia, 14/5; Beltrannya, 1/1; Culicoides, 9/2; Dipheonyia, 14/4; Hoffmania, 1/1; Meijershelea, 4/3; Monoculicoides, 1/1; Oecacta, 14/4; Trithecoides 21/4. Thus, in terms of preponderance, the concerned subgeneric line-up is : Trithecoides > Avaritia = Dipheonyia = Oecacta > Culicoides > Meijershelea > Beltrannya = Hoffmania = Monoculicoides.

The by-far greater specieswise diversity of the subgenus Trithacoidea in the study area is noteworthy and it is in no way in conflict with the finding that in the Gangetic plains of West Bengal, C. pyratona of the subgenus Oocasta comprised of 78.51% of the Gulicoidea populations (Dasgupta, 1961). One reason for this is perhaps due to the fact that in the present study an emphasis was given on that subgenus.

The inclusion of the Fortis and the Similis Group of species under subgenus Oocasta by Majumdar and Dasgupta (1972) is inept, in light of present day knowledge, and those are now included under the Neotropical subgenus Diphacovia. Similarly, their inclusion of their new species, C. distinctipalpis in the Sognis Group under subgenus Oocasta is unnecessary and the species is now included in the Similis Group of subgenus Diphacovia. Their placement of the Actoni Group of species under subgenus Oocasta was also changed now by including the Group under subgenus Avaritia following Dyce and Wirth (1983) who pointed out the Avaritian features of the species of the group so cogently. Wirth (1973) in his checklist of the Oriental Gulicoidea kept some 9 species occurring in India in the "Unplaced" category, the species involved being : clavipalpis, distinctus, fulvus, himalayae, huffi, inexploratus, molantior, odiceus and similis. Thus 9 species are now allocated to subgenus and group to which they should belong (vide table 5).

4. The analyses of species distribution in different districts of West Bengal having a variable soil and vegetational make up and differential meteorological factors make an interesting reading. Though the very limited studies at a very uneven level made now for different districts hardly equip us with comprehensive field data to advance any significant contentions, an indication, however, may be obtained about the species types of different localities. It follows from the work that districtwise occurrence of Culicoides species types are (no. of species shown in parentheses after district name): Bankura (4), Birbhum (3), Burdwan (16), Calcutta (19), Coochbehar (4), Darjeeling (44), Hooghly (16), Howrah (2), Jalpaiguri (2), Malda (4), Murshidabad (2), Nadia (2), Midnapore (?), Purulia (2), ~~24~~ Parganas (34) and West Dinajpur (3). The subhimalyan district of Darjeeling lying between 90 m to over 2000 m altitudinal height from sea level, composed both of hill soils and new alluvial soils and having annual rainfall to the extent of 360 cm and a cool temperature in its mountain area but hot, humid in its plains provides the highest record of 44 species of Culicoides of which a total of 29 species are exclusively described from that district. The Asterinervis Group of species (subgenus Culicoides), the Haematopetus Group of species (subgenus Birphaomyia), the Homotomus Group of species (subgenus Monoculicoides), and one of the Hegneri Group of

species (subgenus Heliocheilus), the Chaetophthalmus, the Heliophilus and most of the Heavel Groups of species (subgenus Cocacta) and 10 new species of subgenus Trithecoidea are found to occur in that district alone. Amongst them, the record of the Aterinervis Group of species and of the Chaetophthalmus Group of species, confirmed now, seems significant - the Darjeeling species of the Aterinervis Group are found to be comparable with those of the same group recorded by Belfinado (1961) in the mountain areas of the Philippines while those of the Chaetophthalmus Group of species occur in colder climate of the Northern Hemisphere and as their distribution extends southward, they occur only in the higher elevations.

As opposed to the faunal peculiarities observed now, as stated above, the Culicoides species of the southern plains also present many specialities. The dominant species C. oxytoma, and the abundant species C. peregrinus of the southern plains of West Bengal are either absent or in stray, occasional number in the Darjeeling area. The restricted records districtwise only of a number of Culicoides species is also noteworthy, and it needs further future studies, on a comprehensive scale, to show that these are truly regional, adapted to the special climatic conditions of their place of occurrence.

5. As per our present knowledge, some 14 species of the West Bengal Culicoides are known to occur in other States of India, the species being ; Actoni, anophelia, brevitarzia, distinctivalis, flaviscutatus, fortis, fulvus, mukerjii, oxytoma, palmifer, peracrinus, ravivalis, shortti and subnotatus. Again, a total of 23 species of West Bengal Culicoides are also known to be distributed in more than one country outside India (vide table 5), those most widely distributed being actoni, anophelia, arakawai, brevitarzia, circumscriptus, glayivalis, hesneri, imicola, oxytoma, palmifer, peracrinus and similis. Of course, it is apparent that as large areas in India and several other parts of southeast Asian countries are explored more intensively in future and new data on Culicoides distribution are added, one or two or a few little known species may be detected as to have a wider distribution within, however, the pattern that is now described.

Table - 5. Systematic arrangement of Gulicoides spp.,
extant in the State of West Bengal*

Subgenus	Species Group	Species, known sex, main district locations (W. Bengal)
1. <u>Avaritia</u>	1. Actoni Gr.	1. <u>actoni</u> Smith; f-m; Calcutta, Darjeeling, Hooghly, 24-Pargas.
		2. <u>definitus</u> Sen and Dasgupta; f-m; Calcutta, 24-Pargas.
	2. Autumnalis Gr.	3. <u>autumnalis</u> Sen and Dasgupta; m; Calcutta, 24-Pargas.
		**4. <u>dummi</u> Sen and Dasgupta; m; Calcutta, 24-Pargas.
		5. <u>inexploratus</u> Sen and Dasgupta, m; Calcutta, 24-Pargas.
	3. Orientalis Gr.	**6. <u>brevitarais</u> Kieffer; f-m; Calcutta, 24-Pargas.
		7. <u>certus</u> Dasgupta; f; Calcutta.
		8. <u>fulvus</u> Sen and Dasgupta; f-m; Calcutta, 24-Pargas.
		9. <u>himalayae</u> Kieffer; f-m, Calcutta, Darjeeling.
		**10. <u>imicola</u> Kieffer; f-m; Calcutta, 24-Pargas.
		11. <u>molestior</u> Kieffer; f-m; Calcutta, Darjeeling.
		12. <u>odiosus</u> Kieffer; f; Calcutta, Darjeeling.
		13. <u>paralini</u> Dasgupta; f; Calcutta, 24-Pargas.
		14. <u>turridus</u> Sen and Dasgupta; f-m; Calcutta, Hooghly, Midnapur.

* f-m in the table denote female and male sex respectively in which the species is known; a species marked by double asterisks means it is also known from outside India.

Table 5. contd.

Subgenus	Species Group	Species, known sex, main district (W. Bengal)
2. <u>Beltrannymia</u>	4. <u>Circumscrip- tus Gr.</u>	**15. <u>circumscriptus</u> Kieffer; f-m; Burdwan, Hooghly, 24-Pargos.
3. <u>Culicoides</u>	5. <u>Aterinervis Gr.</u>	16. <u>leoresalis</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling. 17. <u>neoresalis</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling. 18. <u>pararesalis</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling. 19. <u>neandoresalis</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling. 20. <u>quasi-resalis</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling. 21. <u>resalis</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling. 22. <u>subresalis</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling.
	6. <u>Innoxius Gr.</u>	**23. <u>innoxius</u> Sen & Dasgupta, f-m; Burdwan, Coochbehar, Darjeeling, 24-Pargos. 24. <u>subinnoxius</u> Majumdar & Dasgupta, n.sp.; m; 24-Pargos.
4. <u>Diphazomyia</u>	7. <u>Clavipalpis Gr.</u>	**25. <u>candidus</u> Sen & Dasgupta; f-m; 24-Pargos. **26. <u>clavipalpis</u> Mukerji; f-m; Burdwan, Darjeeling, Hooghly, 24-Pargos. 27. <u>distinctus</u> Sen & Dasgupta; f-m; Calcutta, 24-Pargos. 28. <u>mukerjii</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling, 24-Pargos.

Table 5. conti.

Subgenus	Species Group	Species, known sex, main district locations (W. Bengal)
	8. <u>Racematotus</u> Gr.	29. <u>paculiaris</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling.
	9. <u>Shortti</u> Gr.	30. <u>shortii</u> Sen & Dasgupta; f-m; Darjeeling, 24-Parga.
		**31. <u>shortii</u> Smith & Swaminath; f-m; Burdwan, Darjeeling, 24-Parga.
		32. <u>smithi</u> Majumdar & Dasgupta, n.sp.; f-m; Burdwan, Hooghly, 24-Parga.
		33. <u>subrotatus</u> Majumdar & Dasgupta, n.sp.; f-m; Bankura, Burdwan, Hooghly, Purulia, 24-Parga.
		34. <u>swaminathi</u> Majumdar & Dasgupta, n.sp.; f-m; 24-Parga.
	10. <u>Similia</u> Gr.	**35. <u>cauceyi</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling, Hooghly, 24-Parga.
		36. <u>distinctinalpis</u> Majumdar & Dasgupta, n.sp.; f-m; Bankura, Burdwan, Darjeeling, Hooghly.
		**37. <u>huffi</u> Causey; f-m; Burdwan, Hooghly, 24-Parga.
		**38. <u>similia</u> Carter, Ingram & Macfie; f-m; Burdwan, Darjeeling, Hooghly, 24-Parga.
5. <u>Hoffmania</u>	11. <u>Peregrinus</u> Gr.	**39. <u>peregrinus</u> Kieffer; f-m; Birbhum, Calcutta, Hooghly, Howrah, Midnapur.
6. <u>Meiorenchela</u>	12. <u>Guttifer</u> Gr.	**40. <u>arakawai</u> (Arakawa); f-m; Burdwan, Hooghly, 24-Parga.

Table 5. contd.

Subgenus	Species Group	Species, known sex, main district locations (V. Bengal)
	13. Hegneri Gr.	**41. <u>hegneri</u> Causey; f-m; Burdwan Darjeeling, Hooghly, 24-Pargos. 42. <u>namithecalis</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling.
	14. Unicalatus Gr.	43. <u>unicalatus</u> , n.sp.; f-m; Burdwan.
7. <u>Monoculicoides</u>	15. Homotomus Gr.	44. <u>neohomotomus</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling.
8. <u>Oecacta</u>	16. Chaetophthalmus Gr.	**45. <u>majumdaris</u> Chu; f-m; Darjeeling. **46. <u>spinulosus</u> Chu; f-m; Darjeeling.
	17. Heliophilus Gr.	47. <u>shashi</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling
	18. Neavel Gr.	48. <u>marginatus</u> Majumdar & Dasgupta, n.sp.; f-m; Hooghly, 24-Pargos. 49. <u>basui</u> Majumdar & Dasgupta, n.sp.; f; 24-Pargos. 50. <u>bengalensis</u> Majumdar & Dasgupta, n.sp.; f-m; Bankura, Birbhum, 24-Pargos. **51. <u>hydnus</u> Wirth & Hubert, f-m; Hooghly, 24-Pargos. 52. <u>fortipalnis</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling. 53. <u>inornatus</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling. 54. <u>pateli</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling. 55. <u>pharrai</u> Majumdar & Dasgupta, n.sp.; f-m; Darjeeling.

Table 5. contd.

Subgenus	Species group	Species, known sex, main district localities (W. Bengal)
		56. <u>shortipennis</u> Majumdar & Dasgupta, n.sp.; f; Darjeeling.
		57. <u>submarginatus</u> , n.sp., m; Darjeeling.
19. Schultzel Gr.	**58.	<u>Oxytoma</u> Kieffer; f-m; Birbhum, Calcutta, Darjeeling, Midnapur.
9. <u>Trithicoides</u>	20. Anophelis Gr.	**59. <u>anophelis</u> Edwards; f-m; Calcutta, Coochbehar; Birbhum; Darjeeling; Hooghly; Malda; 24-Pargas, West Dinajpur.
		60. <u>insolens</u> , n.sp.; f; Darjeeling.
21. Macfieci Gr.	**61.	<u>macfieci</u> Causey; f-m; Burdwan, Midnapur.
		62. <u>pirus</u> , n.sp.; f; Darjeeling.
		63. <u>neopalifer</u> , n.sp.; f-m; Darjeeling.
	**64.	<u>palifer</u> Dasgupta & Ghosh; f-m; Burdwan, Calcutta, Darjeeling, Hooghly, 24-Pargas.
		65. <u>parapalifer</u> , n.sp.; f-m; West Dinajpur.
		66. <u>pseudopalifer</u> , n.sp.; f-m; Darjeeling.
		67. <u>quincipalifer</u> , n.sp.; f; Darjeeling.

Table 5. contd.

Subgenus	Species group	Species, known sex, main district, locations (W. Bengal)
		68. <u>rariacantha</u> , n.sp.; f-m; Midnapur.
		69. <u>subpalpifer</u> , n.sp.; f; Darjeeling.
22. Flavesceus Gr.		70. <u>annarunguis</u> , n.sp.; f-m; Darjeeling.
		71. <u>maldaensis</u> , n.sp.; f; Malda.
		72. <u>pseudoflavescens</u> , n.sp.; f; Malda.
		73. <u>usitatus</u> , n.sp.; f; Darjeeling.
23. Haripalpis Gr.		74. <u>clarus</u> , n.sp.; f-m; 24-Pargos.
		**75. <u>flavicutatus</u> Wirth & Hubert; f-m; Darjeeling.
		76. <u>infrequens</u> , n.sp.; f-m; 24-Pargos.
		77. <u>pallidus</u> , n.sp.; f; Darjeeling.
		**78. <u>paripalpis</u> Smith; f-m; 24-Pargos.
		79. <u>singularis</u> , n.sp.; f; Darjeeling.

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