A REVISION OF THE SUB-FAMILY SARCOPHAGINAE IN THE ORIENTAL REGION.

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I. INTRODUCTORY.

The present work has been prepared during the recent period of depression in the Plantation Rubber Industry, which had resulted in putting a temporary stop to most of the author's work as Malariologist to one of the large Companies, owing to the necessity of reducing expenditure to a minimum, with consequent inability to travel.

It is hoped that the elucidation of the Oriental species of a genus which is being constantly met with both by the Medical and Agricultural Entomologist in the course of their investigations as well as falling in large numbers to the net of the general collector of Diptera will prove useful. As will be shown in the various sections of this paper the Sub-family, and especially the genus *Sarcophaga*, presents numerous problems of a most interesting kind to the Geneticist, the Sanitarian and others interested in various aspects of Entomology. Heretofore, owing to complete lack of knowledge regarding the species, in *Sarcophaga* especially, no progress has been possible, and results have always had to be expressed in a wearying repitition of "*Sarcophaga sp.*" So late as 1921, when the writer was compiling his "Diptera of the Khasia Hills," (Senior-White, 1922), he had to confess himself completely stultified in any attempt to identify in the "family." My note book for the period contains a table in which I attempted to tabulate the species known to me at that time on external characters. I see that I

distinguished eleven, and on the strength of Howlett's (1909) statement that " about eight species of *Sarcophaga* appear to be known from this country " (India) fondly conceived that the whole muster of the genus in India was probably before me!

However, I was no further forward in regard to specific identifications, and though I hold with Townsend that it is less harmful to create fresh synonomy by describing as new indeterminable species until type elucidation is possible than to leave such unnamed, I hesitated to follow this course in a genus where there seemed no definite external characters to be got hold of. I am now thankful that I refrained. Had I attempted descriptions on such the results would have been just as useless and intangible as, for instance, Taylor's (1917) recent description of his *Sarcophaga froggatti* from Australia which, though it covers more paper, is as useless for subsequent recognition of the species as any effort of Francis Walker!

Meanwhile, in working on the species of *Bengalia* I for the first time made use of the genital apparatus in Tachinoid Muscids, and, on the wealth of characters thus revealed, determined that I would re-tackle *Sarcophaga* on the first opportunity, having regard to the necessity of elucidating the genus for the revision of the Oriental Muscidae which is being undertaken by Major Patton and myself. At this time I was ignorant of the great work of Böttcher on the European forms, which only became known to me during the course of these investigations. Most of the figures given in this paper were drawn before I obtained access to Böttcher's figures, often of the same species.

The chance I had been awaiting occurred owing to the condition of affairs described in the opening paragraph, and, seizing the opportunity, the last ten months have been devoted almost entirely to the study of *Sarcophaga* and its allies. The muster of the species of the main genus in India has been increased, as the result, from " about eight " to thirty-five.

The material available to me for the investigation has been everything that exists in Indian official collections, in the private collections of Major Patton and myself, and the Oriental material in the Austrian State Museum, Vienna. The latter has proved invaluable in regard to the Far East, material from which, as would be expected, was almost entirely absent in Indian departmental collections. The total material examined in *Sarcophaga* has amounted to 2,785 specimens, divided as follows :—

Collection.	Species.	Determinable specimens.	Indeterminable specimens.	TOTAL.
Colombo Museum	5	13	12	25
Imperial Forest Dept.	8	75	27	102
Imperial Agricultural Dept.	21	574	464	1038
Madras Agricultural Dept.	15	137	93	230
Punjab Agricultural Dept.	1	31	..	31
Zoological Survey of India ..	22	199	181	380
Cambridge University	5	11	10	21
Austrian State Museum	21	73	49	122
Major Patton	12	438	190	628
Author's collection	13	208	..	208
TOTAL	1,759	1,026	2,785

In other genera the Austrian State and Indian Museums and my own collection have furnished 137 specimens only, which reveals the numerical dominance of *Sarcophaga* over the remainder of the Sub-family.

With such a mass of material a thorough revision has been practic able. For it I have to thank Mr. G. M. Henry, Assistant in Systematic Entomology, Colombo Museum ; Dr. J. C. Hutson, Government Entomologist, Ceylon ; Mr. C. F. C. Beeson, Forest Entomologist to the Government of India, and his Systematist, Dr. M. Cameron ; Mr. E. Ballard, Government Entomologist, Madras and Mr. Afzal Hussain, Government Entomologist, Punjab. Major Patton not only handed over to me his large private collection, but also a Mesopotamian collection from Prof. Nuttall of Cambridge, which has proved invaluable in regard to the distribution of species to the west of the Region. To Dr. N. Annandale, Director of the Zoological Survey of India, and to Mr. T. Bainbrigge Fletcher, Imperial Entomologist, my thanks are not only due in the same regard, but even more so for the continuous help they have afforded to me in acceding to my constant demands for references and copies of descriptions from publications inaccessible to me. Without this aid, and the permission accorded to me to borrow literature from the library of the Agricultural Research Institute, Pusa, such synonomy as has been achieved would have been impossible. For the loan of publications from his official library I have also to thank Dr. J. Pearson, Director, Colombo Museum. Further, I have to thank Dr. R. R. Parker, of the United States Public Health Service, the recognized Specialist on the group in America, for advance copies of a paper by himself dealing with Oriental forms which was passing through the press, and also for a named collection of Philippine and other material. To the Curators of the various Continental collections who most courteously replied to my queries regarding types, and most especially to Dr. Zerny of Vienna, who actually entrusted to me the types in his charge, I would also record my deep obligations. With one exception, all my letters asking for information or soliciting the loan of collections for study met with a ready response. After so much kindness and assistance I can only hope that the results of the work will be found worthy of acceptance by the Entomological World.

II. HISTORICAL.

One hundred and twenty-nine years have gone by since the first species of this Sub-family was described from the Oriental Region by Fabricius. Thereafter, the increase in our knowledge of the group can be divided into two periods, one covering the first century and the other the last two decades.

First Period, 1794-1896. Description during this period followed the usual methods of systematic entomology and was confined to macroscopic external characters, chiefly those of colour. Throughout the group, and especially in its principal genus *Sarcophaga*, these are singularly uniform, and save in the case of one or two very marked species, hardly enable the subsequent worker to decide more than that the species before the original describer is correctly allocated generically.

No less than half the total of species in the main genus are due to Walker, to state which is almost tantamount to saying that the description is unrecognizable, and is really worth no more than to call attention to the existence of a type. If this type has perished, the species becomes for ever indeterminable.

The results of this period were collected by van der Wulp (1896), whose catalogue in this group, as throughout the Order, must form the basis of all subsequent progress in Oriental Dipterology. None the less, the sex of the type-specimen is not therein stated and, as will be shown subsequently, this is of primary importance in the Group. In the subjoined list taken from Wulp's Catalogue this point is added from the original descriptions, and is further enlarged by notes taken by the late Mr. F. M. Howlett and Major Patton from Wulp's own copy of his work, now in the possession of Col. Yerbury. Mr. Howlett's copy passed into my possession after his demise in 1920. In regard to the list, where various localities are given for a species, implying recognition thereof by its author or a subsequent worker, the later ones are to be regarded as practically worthless. The first locality mentioned is the type locality.

Sarcophaginae.

Phrissopoda, Macquart.

Suit. à Buff., II, 222 (*Phrissopodia*) (1835).

Ph. metallica, Wulp, *Dipt. Sumat. Exp.* 43, 1, pl. iii, fig. 1 (1881). Sumatra.

The genus is sunk by Aldrich (1905) in *Peckia*, R.-D.

Cynomyia, Robineau-Desvoidy.

Essai sur les Myodaires, 363 (1830).

C. violacea, Macq., *Suit. à Buff.*, II, 233, 2 (1835) .. Java.
C. quadrivittata, Macq., *Dipt. Exot.* supp. 5, 108, 4 (1855)... E. India.
C. fortis, Wlk., *Proc. Linn. Soc. Lond.*, I, 127, 116 (1857) .. Borneo.
C. fulviventris, Rond., *Ann. Mus. Civ. Genca*, VII, 425 (1875) Borneo.

Sarcophaga, Meigen.

Syst. Besch., V, 14 (1826).

S. ruficornis, F., *Ent. Syst.*, IV, 314, 6 (1794). Sex not stated .. .. .. E. India.
Subsequently noted by Wulp .. .. N. India. Siam
S. princeps, Wd., *Auss. Zweifl. Ins.*, II, 359, 8 (1830) ♂ .. Hindostan. China. Malacca. Sumatra.
S. taenionota, Wd., *loc. cit.*, II, 360, 12 (1830) ♂ ♀ .. Java, etc.
S. rufipes, Wd., *loc. cit.*, II, 362, 14 (1830) ♂ .. Egypt.
Su sequently noted by Wulp .. .. Deesa.
S. fulvicornis, R.-D., *Myod.*, 341 (1830). Sex not stated Bengal.
S. duvaucellii, R.-D., *Myod.*, 351 (1830). Sex not stated .. Bengal.
S. tenuipalpis, Macq., *Dipt. Exot.*, II, iii, 101, 9 (1842) ♂ .. Pondicherry.
S. lineatocollis, Macq., *loc. cit.*, II, iii, 101, 10, pl. xii, fig. 2 (1842) ♂ ♀ ... . Java. Ceylon.
S. javana, Macq., *loc. cit.*, supp 4, 232, 30 (1851) ♂ ♀ .. Java.
S. sericea, Wlk., *Dipt. Saunds.*, 326 (1851). Sex not stated E. India.
Subsequently noted by Wulp .. .. Ceylon.
S. reciproca, Wlk., *Proc. Linn. Soc. Lond.*, I, 22, 74 (1857) ♀ Singapore.

S. aliena, Wlk., *loc. cit.*, I, 22, 75 (1857) ♀ .. Mount Ophir.
Borneo.
Wulp adds in ms. that this sp. equals. *lineatocollis*, Macq.[1] Celebes.
S. indicata, Wlk., *loc., cit.*, I, 127, 118 (1857) ♂ .. Borneo.
S. compta, Wlk., *loc. cit.*, III, 102, 92 (1859) ♀ .. Aru Ids.
S. invaria, Wlk., *loc. cit.*, III, 103, 93 (1859) ♂ ♀ Celebes.
Aru Ids.
S. basalis, Wlk., *loc. cit.*, III, 129, 8 (1859) ♂ .. Kei Ids.
S. mendax, Wlk. *loc. cit.*, IV, 132, 120 (1860) ♂ .. Makassar.
Gilolo.
S. inextricata, Wlk., *loc. cit.*, IV, 132, 121 (1860) ♀ .. Makassar.
S. sericeonitens, Wlk., *loc. cit.*, V, 158, 47 (1861) ♀ .. Amboina.
Geram.
Philippines.
S. aurata, Wlk., *loc. cit.*, V, 158, 48 (1861) ♂ ♀ .. Amboina.
S. innotata, Wlk., *loc. cit.* VII, 214, 60 (1864) ♀ .. Mysol.
S. brevis, Wlk., *loc. cit.*, VII, 236, 32 (1864) ♀ .. Geram.
Philippines.
S. perpusilla, Wlk., *loc. cit.*, VIII, 115, 38 (1865) ♂ ♀ .. New Guinea.
Wulp notes in ms. that the type is lost.
S. aurifrons, Dol., *Nat. Tijd. Ned. Ind.* XVII, 109, 59 (1858-9). Sex not stated .. .. .. Amboina.
S. frontalis, Dol., *loc. cit.*, XVII, 110, 61 (1858-9). Sex not stated .. .. Amboina.
S. frontalis, Thoms., *Dipt. Eugen. Resa.*, 535, 150 (1868) ♂ ♀ Manila.
Ross Id.
S. spininervis, Thoms., *loc. cit.*, 538, 156. ? ♀ .. Manilla.
S. emigrata, Rond., *Ann. Mus. Civ. Genoa*, VII, 424 (1875) ♂ Borneo.
S. rufipalpis, Wulp, *Dipt. Sumat. Exp.*, 42, 2 (1881) ♂ ♀ .. Sumatra.

An absolute homonym of *S. rufipalpis*, Macq., *Dipt. Exot.*, II, iii, 102, (1848), from Brazil. This species had been recognized by Wulp himself in *Leyden Mus. Notes*, IV, 88, and *Tijd. v. Ent.*, XXVI, sep. 36.

Sarcophila, Rondani.

Dipt. Ital. Prodr., I, 86, (1856).

S. alba, Sch., *Dipt. Novara Reise*, 315, 69 (1868) ♂ ♀ .. Ceylon.

Noted by Wulp in ms. as a synonym of *Musca cinerea*, Fb., *Ent. Syst.* IV, 331, 32 (1794), which is placed by Wiedemann in *Tachina*, *Auss. Zweifl. Ins.*, II, 297, 29, and so recorded in Wulp.

Catapicephala, Macquart.

C. splendens, Macq., *Dipt. Exot.*, supp. 4, 237 (1851) .. Java.

Agria, Macquart.

Hist. Nat. Insect. Dipt., II, 229 (1835).

A. nuba, Wd., *Auss. Zweifl. Ins.*, II 296 (1830) .. Nubia.
Recorded on a specimen at the British Museum from .. Karachi.

As will be shown subsequently, certain of these genera are very doubtfully included here, and may have to be transferred to other Sub-families. With one exception they are represented by only one or two Oriental species each the determination of which is therefore simple, but *Sarcophaga*, with twenty-nine species, consists of an inchoate mass of descriptions which by themselves defy elucidation, and this genus, for all practical purposes, represents the Sub-family in the East.

[1] According to Howlett's copy. Wulp's copy gives the note against *indicata*, the next species, with a ?

Second Period, 1896-1923. The chaotic state of affairs thus shown to exist among the Oriental species was exactly paralleled in Europe, where the tale of the Palearctic species had likewise mounted to a vast mass of descriptions, equally unrecognizable, when, in the very year which saw the summation of the Eastern chaos in Wulp's Catalogue, a blaze of light was thrown into the darkness by the work of Pandellé (1896) who, for the first time, showed what valuable specific characters were afforded by the varying conformation of the parts of the male genitalia. As Böttcher (1912b) says, " he hoped, with the aid of the new auxiliary, to circumscribe the number of good species," instead of which he found that there were very many species which, owing to their absolute lack of external distinguishing characters, had never been described at all, and the species of the older authors, so far from being largely synonyms, were mere mélanges of undistinguished groups of species. Having distinguished his species by the aid of the genitalia Pandellé proceeded to examine the now securely separated species for external characters and brought to light many points, mainly of chaetotaxy, which had hitherto been overlooked or disregarded owing to their apparent variability within the " species." Fulsome as it is, the tribute paid by Böttcher (1912b) to Pandellé is none the less well merited, for he showed that in the case of closely allied species difficult or impossible of separation on externals the surest guide to identity or distinctness is obtainable from the male genitalia, and thus founded the modern study which has led to such clarity of concept in other families, such as Culicidae.[1]

Pandellé's paper was published without figures of the structures discovered, and these were for the first time illustrated by du Roselle (1904) in a paper quite inaccessible outside the largest European libraries.

The newly discovered method was at first opposed by Dipterists of the standing of Strobl (1910), but the validity of the method was rapidly appreciated, and Villeneuve, in Kertesz, " Catalogue of the Palearctic Diptera " was able to clear up in a few years the synonomy of most of the Palearctic species of *Sarcophaga.* Subsequently, after elucidating the types of Meigen and Pandellé at Paris, (Böttcher, 1912 a), Böttcher published a long paper (1912 b, c,1913 a-d), in which for the first time the species of the Palearctic Region were revised together and the determination of any particular specimen, (so be it is a male), rendered easy and practicable. Nonetheless, admirable as Böttcher's brief descriptions and figures are, his table of species is awkward in the extreme. It is scattered right through the five parts of the paper devoted to description, and is not dichotomic, and the present opportunity is taken to present it in dichotomic form in Appendix I, for the benefit of European workers. In this paper Böttcher recorded four Palearctic species as Oriental.

But, easy as the males have now become to distinguish, the female sex still lies in a welter of confusion. With few exceptions the female genitalia offer no separatory characters worthy of mention. It is not

[1] Nevertheless, forty-two years earlier, Osten-Sacken, the founder of the other great key to distinction chaetotaxy, had proposed, in his first published paper, in 1854, to classify the *Tipulidae brevipalpi* on the male genitalia.

in *Sarcophaga* alone that this difficulty has been encountered, it occurs in every order of insects in which the separation of closely allied species rests on the male genital armature. Only bred females, or those taken actually *in cop.*, are determinable. That the organs of this sex which, in the copulatory act, have to fit themselves to such diversely constructed pieces of apparatus as the male genitalia have proved themselves to be should really show no differences *inter se* is inconceivable, but it has to be admitted that not only in *Sarcophaga* but also in Culicidae, where the method has been made use of more than in any other Family of diptera, such have not yet been made out. The basis of the belief that differences in male genitalia are specific is that such prevent inter-breeding, but if the female genitalia are really constructed on one pattern only, then any form of male genitalia should be able to effect connection with them. It seems certain that this is not the case, and it is greatly to be hoped that future research will reveal where the differences which inhibit cross-breeding lie. Whereas in Siphonaptera, as Rothschild (1914) has shown, three closely allied species of *Xenopsylla* can be as easily separated by the shape of the female spermathecae as by that of the male external genitalia, yet in Culicidae, in which alone in Diptera an attempt has been made to discover such differences, MacFie and Ingram (1922) have shown that while there is ample that is generic there is nothing that is specific so far discoverable.

Meanwhile, during these developments in Europe, the species of the Orient had remained untouched. The flood of species making had ceased with Wulp's homonym of 1881, and for thirty-two years thereafter no new additions to the Fauna of South Asia were described. In 1912 however Böttcher, armed with his new knowledge of the Palearctic forms, entered the Oriental field and in two separate papers (1912 d and 1913 e) not only added ten new species to the Fauna, but was able to show that a further two Palearctic species reached the eastern shores of Asia in Formosa. Further, in the appendix to his Palearctic paper (1912 d) Böttcher recognized from that Island and from Calcutta one of the old species of the " first period " of Oriental description, which was again recognized five years later by Parker (1917), who had meantime become the recognized specialist on the Sub-family in America. That author, in the same paper, added yet four more species to the list. Subsequently, (Parker, 1919), he established some synonomy and a new sub-species from the Orient, which, in his last paper, (Parker 1923), he raises to specific rank, whilst at the same time describing two more closely allied Oriental species and another new species related to one of Böttcher's Formosan ones.

The results of this " second period " are tabulated below :—

PALEARCTIC SPECIES FOUND TO BE ORIENTAL :—

S. melanura, Meig., *Syst. Besch. Europ. Zweif. Ins.*, V, 23 (1826)	Formosa.
S. albiceps, Meig., *loc. cit.*, V, 22 (1826)	N. India. Hong Kong. Formosa. Colombo. New Guinea.

S. haematodes, Meig., *loc. cit.*, V, 29 (1826)	Mussooric.
S. haemorrhoidalis, Meig., *loc. cit.*, V, 28 (1826) ..	Darjiling.
	Nicobar Ids.
S. dux, Thoms., *Dipt. Eugen. Resa*, 540 (1868).	Japan.
	Formosa.
Böttcher's records of this species are given under its synonym of *tuberosa*, Pand.	Guam.
	Hawaii.
	Singapore.
S. falculata, Pand., *Rev. d'Ent.* XV, 185 (1896) ..	Mussooric.

NEW SPECIES ADDED TO THE ORIENTAL FAUNA :—

S. krameri,[1] Bött., *Ent. Mitteil.*, I, 165 (1912) ♂ ♀ ..	Formosa.
	Singapore.
	Colombo.
S. longicornis,[2] Bött., *loc. cit.*, I, 166 (1912) ♂	Formosa.
S. tristylata, Bött., *loc. cit.*, I, 167 (1912) ♂ ..	Formosa.
S. caudagalli, Bött., *loc. cit.*, I, 167 (1912) ♂ ..	Formosa.
S. fuscicauda, Bött., *loc. cit.*, I, 168 (1912) ♂ ..	Formosa.
	Singapore.
S. josephi, Bött., *loc. cit.*, I, 168 (1912) ♂	Formosa.
S. calicifera, Bött., *loc. cit.*, I, 169 (1912) ♂ ♀ ..	Formosa.
	Colombo.
S. orchidea, Bött., *Ann. Mus. Nat. Hung.*, XI, 375 (1913) ♂	Formosa.
	Calcutta.
	Colombo.
	New Guinea.
S. phoenicopterus, Bött., *loc. cit.*, XI, 376 (1913) ♂ ..	Formosa.
S. antilope, Bött., *loc. cit.*, XI, 380 (1913) ♂ .. .	Formosa.
S. crinita, Park., *Proc. U.S. Nat. Mus.*, LIV, 92 (1917) ♂ ♀	Philippines.
S. orientalis, Park., *loc. cit.*, LIV, 94 (1917) ♂ ..	Philippines.
S. knabi, Park., *loc. cit.*, LIV, 96 (1917) ♂ ..	Philippines.
S. luzonensis, Park., *Bull. Brook. Ent. Soc.*, XIV, 43 (1919) ♂	Philippines.
	Queensland.
S. ceylonensis, Park., *A. M. N. H.*, (9) XI, 125 (1923) ♂ ♀	Peradeniya.
S. craggi, Park., *loc. cit.*, (9) XI, 126 (1923) ♂ ♀ ..	Madras.
	Nyassaland.
S. hutsoni, Park., *loc. cit.*, (9) XI, 127 (1923) ♂ ♀ ..	Peradeniya.
	Madras.

Now, as has been shown earlier, the recognition of a *Sarcophaga* female by itself is impossible, hence we can delete from the two foregoing lists all the species of the first period with female types, *i.e.*, *reciproca*, *aliena*, *compta*, *inextricata*, *sericeonitens*, *innotata*, *brevis*, Walker and *spininervis*, Thomson, and also *fulvicornis* and *duvaucellii*, Desvoidy and *perpusilla*, Walker of which the types are lost. Further, of the three homonyms, *frontalis*, Thomson and *rufipalpis*, Wulp, being unrecognizable without type examination, need trouble us no further. If ever elucidated, no change in nomenclature is involved if they are found to have been subsequently described. *S. longicornis*, Böttcher I would hereby rename *formosana*. Out of the fifty-two described species, therefore, eleven need be no further considered. Of the remaining forty-one, twenty-three, or just over half, are either recently described species or properly elucidated Palearctic ones, at once recognizable by the published figures of their male genitalia.

This then was the position when the writer commenced the study of the Sub-family in the Oriental Region.

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[1] The female is described by Böttcher in 1913 e without absolute proof of identity with the earlier described male. The Colombo record rests on this determination.

[2] Preoccupied by *longicornis*, Macquart.

III. TYPE ELUCIDATION.

The species of the first period which still remain presumably recognizable, and which require elucidation and synonomyzing, number eighteen. Before finality in nomenclature can be expected it is essential that these names be dealt with. At the commencement of my studies, therefore, I wrote to the Curators of the Entomological collections of the various European Museums in which these types are deposited, with the following results :—

Dr. Lundbeck, University Zoological Museum, Copenhagen, replied :— " of *S. ruficornis* we have in the collection of Lund two specimens, both females ; our specimens are evidently not types as Fabricius says ' Dom. Lund ' and not ' Mus. Dom. Lund.' The type is then in Fabricius' collection at Kiel. *S. princeps* in Westermann's collection is one male, labelled ' Sumatra, Trentepohl,' I think the type : *S. taenionota* : in Westermann's collection is a male from Batavia and a female from Tranquebar ; as Wiedemann says ' in Westermann's und meiner Sammlung ' these specimens are at all events co-types. Thus it seems that we have here a type of *princeps* and a co-type of *taenionota ;* but I am sorry that I am obliged to say, that we dare not extirpate the genitalia of these old specimens."

Professor Séguy, Muséum National d'Histoire Naturelle, Paris, replied :—"... .votre lettre relative aux Sarcophagides de la collection Macquart. Malheureusement le réglement du Musée s'oppose à la dissection des types et M.le Prof. Bouvier n'a pas pu donner l'autorization."

Professor Zerny, Austrian State Museum, Vienna, replied :—" I have no time to dissect the specimens of *Sarcophaga* that you wish to examine, but I am prepared to send you the specimens and our whole Oriental material of *Sarcophaga.*"

Professor Sjöstedt, Naturhistoriska Riksmuseets, Stockholm, replied :— " will ich mitteilen, das *Sarcophaga frontalis* von ♂ ♀, *spininervis* von 2 wahrscheinlich ♀♀ in der Typensammlung von Exp. ' Eugenies Resa ' representiert sind. Zerreisung den unersetzlichen Typen kann ich nicht vornehmen."

Regarding the types of Walker, at South Kensington, in spite of several letters I have been unable to elicit even an acknowledgment ; whilst I was equally without a reply regarding the Rondani type, which is presumably in the Museo Civico di Storia Naturale, Genoa.

Mr. R. van Eecke, Conservator of the Srijks Museum van Natuurlijke Historie, Leyden, replied :—" .*Sarcophaga rufipalpis*, Wulp. The type specimens are here in the Leiden Museum of Natural History, a single male and ditto female. It is not permitted to send the types to foreign specialists and I cannot dissect the genitalia. This dissection also is not permitted by the Director, Prof. Dr. E. H. van Aort."

Regarding the Fabrician type at Kiel, as indicated by Dr. Lundbeck, Major Patton, who last year visited nearly all the Continental Museums on type examination for our joint work, writes me recently :—"I went to Kiel first and there discovered that the whole of the types of diptera of Fabricius were destroyed,. ...in the four drawers only pins and labels were left, all the specimens had been destroyed by beetles and

other insects. They were preserved on wax, it had cracked and the wood was also cracked and left spaces through which the destroying insects gained access."

This then is the result of my attempt to elucidate the eighteen Oriental type-specimens of the first period. Of the European Museums, Copenhagen, Paris, Stockholm and Leyden are apparently debarred by their rules from permitting type dissection,—(one is forced to wonder how, in the face of this, Böttcher succeeded (1912 a) in elucidating Meigen and Pandellé's types at Paris),—whilst from London and Genoa no reply was received. Vienna alone gave facilities for type examination, the results of which are given below, but, to my great surprise and disappointment, the types of Doleschall were not included in the collection, and do not seem to be there. As it is generally understood that this Author's types are at Vienna, it must be supposed that those of his two species of *Sarcophaga* have perished. The only definite type sent me was that of *Sarcophila alba*, Schiner, though there was other material of immense value. In a subsequent communication, when forwarding the collection, Dr. Zerny wrote, " we have the type of one species only that you are anxious to see." This must refer to the above mentioned species.

The position then is as follows :—the type of *S. ruficornis*, Fab. was at Kiel and is now destroyed. The type of *S. princeps*, Wd. is at Copenhagen and inaccessible. The location, if in existence, of the type of *taenionota*, Wd., is uncertain. The types of *duvaucellii* and *fulvicornis*, R.-D., like most of that author's, have probably perished, Prof. Séguy in his reply to my letter makes mention only of the Macquart types. The types of *tenuipalpis*, *lineatocollis* and *javana*, Macquart are at Paris and inaccessible. The type of Walker's *perpusilla* is known to have perished, that Author's remaining seven species with male types are seemingly lying in state at South Kensington, the dignity of their repose apparently unworthy of interruption by the "'οι πολλοι of dipterology." The Doleschall types are not to be found. The two Thomson types at Stockholm are inaccessible, but, since one is only represented by females and the other is a homonym, this is the less regrettable. The same applies to the inaccessible van der Wulp type at Leyden. The Rondani type I have been unable to find out anything about, though I asked for the information through Prof. Bezzi of Turin. The upshot is then that whatever results in nomenclature are now arrived at, these must always be liable to upset when *princeps*, *taenionota*, *tenuipalpis*, *lineatocollis*, *javana*, *sericea*, *indicata*, *invaria*, *basalis*, *mendax*, *aurata*, *frontalis* and *emigrata* are elucidated. These thirteen names lie like known but incorrectly charted rocks in the fairway, the Governments within whose territories they lie being neither willing to locate and light them themselves or to permit another to do so for them.

At this point I placed the position before Dr. Annandale, Director of the Zoological Survey of India, as *ex officio princeps* of Oriental zoology. His reply runs as follows :—" I think you will be perfectly justified in acting boldly in your *Sarcophaga* paper, providing that you explain your attitude and are quite sure of your ground. My own recent work on the Molluscs has taught me that ' anatomical ' characters are

apt to become an obsession and may be just as variable as more superficial ones. *Type specimens that cannot be used for scientific investigation are, in my opinion, no true types but merely a fetish of museum-minded persons. You might call them 'heirotypes.'* "

The italics in the foregoing are my own, and Dr. Annandale's opinion is my justification for the new species of the present paper. None the less, I sincerely hope that its publication will stimulate those in whose charge the heirotypes lie to rescue them from the oblivion their inability to permit their elucidation enforces upon them, and to once more bring them into the category of recognized types of valid species. The present position is anomalous and unfortunate, and is not in the best interest of scientific progress.

IV. RECOGNITION OF THE SPECIES OF THE EARLIER AUTHORS.

Two species of the first period have been recognized of recent years in various papers. Apart from this, however, the collections of the Indian and Vienna Museums contain a number of specimens determined by various workers. It was necessary, therefore, to examine the evidence for such determinations, and if found satisfactory to adopt the name as 'recognized.' In every case the specimen was again determined by genitalia examination.

S. ruficornis, F. was recognized by Böttcher, first in his Palearctic paper, (1913 d), in which he records a male and two females from Calcutta, many females from Formosa, and states that Villeneuve has it from Socotra, and secondly in his second Formosan paper (1913 e), which was apparently prepared simultaneously with his Palearctic one. He gives no figure, but in 1913 d states that the superior claspers resemble those of *securifera*, Villen., and in 1913 e he enters into a detailed comparison between the two species. Parker (1917) for the first time figured the genitalia of the species, following Böttcher in his determination. In the Indian Museum collection I find that Bigot, and in the Vienna Museum collection that Brauer and von Bergenstamm, had recognized *ruficornis* in the same species. The type has perished, but it seems safe and wisest to accept a determination in which every author has been in accord and to definitely adopt the Fabrician name for the species of which the genitalia are figured in fig. 5 of Parker (1917).

None the less, this is not the only species with antennae and genital segments red in colour. *S. ballardi*, n. sp., is similar in this respect. The Fabrician type of *ruficornis*, from ' East India,' came presumably from Tranquebar, and *ballardi* is also a South Indian species. Hence there is occasion for a certain amount of doubt as to *ruficornis*, but, as stated above, it seems wisest to accept the determination which all previous writers have been agreed upon.

Austen has again, more recently, recognized the species in material sent him from the North-West Frontier by Sinton, (1921), whose short description of the adult is quoted from Austen (1910). As the species now adopted as true *ruficornis* alone reaches North-West India Austen's determination almost certainly applies to it. Larvae of this have been

sent to Major Patton, for comparison with Sinton's material, now with him.

S. princeps, Wd. The Indian Museum contains a male so labelled by some unknown worker. Dr. Annandale informs me that before his time some diptera were named for the Museum by Becker, but the writing on the label is almost printed, and whether the latter is responsible for the determination is uncertain. The specimen, which is very old, is *S. albiceps*, Meig. What Wiedemann's species is, therefore, is quite uncertain, and his name applies only to his heirotype.

S. taenionota, Wd. The Vienna Museum contains a specimen so labelled, but without the name of the determiner. It cannot thus have been Brauer and von Bergenstamm, all of whose determinations bear a special label so stating. The name label is modern, in a clerkly hand, and was presumably not written by Wiedemann, neither does the specimen, which is undated, appear so old. On examination it proves to be *S. knabi*, Park. var. *flavipalpis*, nov. If it could be shown that this specimen is Wiedemann's type, then the later names fall, and Parker's species becomes a valid variety of Wiedemann's.

The Indian Museum also contains a specimen, labelled by the same unknown worker as in the case of *princeps*, as '*taenionota*,' which on examination proves to be *haemorrhoidalis*, Meig. The two attempts to recognize *taenionota* have resulted therefore in so labelling two widely separated species, and unless the first of these proves to be the type-specimen the species must await the discovery and elucidation of the latter for recognition.

S. rufipes, Wd. has been shown by Böttcher on type examination (1913 d) to be only a colour variety of *hirtipes*, Wd., of which he also states that he has seen the type. Böttcher regarded the latter as only a variety of *albiceps*, and in describing his new species *orchidea* he stated that the latter was also nearly related thereto. These conclusions I shall return to later, but on the published figures of *albiceps* and *orchidea* it is easy to recognize *hirtipes* (*rufipes*), Wd., and this species is accorded its Wiedemann name.

S. tenuipalpis, Macq. There is a specimen in the Indian Museum so determined with a query by Bigot, which on examination proves to be *albiceps*, Meig. The determination, of course, is valueless, and the elucidation of the species rests on the examination, at some future date, of its heirotype.

S. lineatocollis, Macq. This species was recognized by Howlett (1909), who stated that it is " one of the commonest " (in India). Howlett was no systematist, his genius ran more on bionomic lines, and the determination was probably given him from the British Museum, though no specimens so labelled are in the Pusa collection. His figure may be any of the smaller species with genital segments blackish. More recently Edwards (1919) has again recognized the species. Thinking that possibly the genitalia of the Macquart type had been examined I wrote for information. Mr. Edwards replied, " my attempted identification of *lineatocollis* was merely based on external comparison with series named by Austen." I make no doubt that this and the other Macquart species are good, and their relegation to heirotypes is most regrettable,

but to attempt to adopt this or either of the other names in the present state of affairs would probably only result ultimately in a mass of references 'nec. Macq.' when that Author's types are, as all heirotypes must be, ultimately properly elucidated. Synonyms are infinitely preferable to homonyms.

S. javana, Macq. A female in the Vienna Museum from Java, in bad order, bears two labels, one reads, '*S. javana,* Macq. nom.' in what is probably that Author's own handwriting, the other is an equivalent determination by Brauer and von Bergenstamm. Possibly this specimen is to be considered as a co-type of the species, but, being a female, I do not care to effect any synonomy on the strength of it. It appears to me to be *S. aurifrons,* Dol., but with a definite male type in existence, I prefer to leave *S. javana* Macq. to its elucidation.

S. aurifrons, Dol. The Vienna Museum collection contains a series so named by Brauer and von Bergenstamm. The species under this name is one of the few which possess really noteworthy separatory characters externally. No other species known to me has the abdomen in both sexes covered with golden pubescence, whilst the abrupt cessation of the black stripes on the apparent third segment, leaving all the fourth unicolorous golden, is equally noteworthy. When we consider Doleschall's description :—" Het achterlijf langwerpig eivormig, vuilgeel, weinig behaard ; met drie zwarte langsstrepen op de 3 eerste buikringen," I think that there is no doubt that this was the species that he had before him, and that his type, of which the sex is not stated, was a female.

A small series in Patton's collection from New South Wales, sent him by Froggatt and so determined, are *knabi,* Park. The determination was probably made solely on the quite noticeable golden colour of the head usual in this species, and without consulting the not very accessible description. Though this complicates the matter, I think it may be disregarded, and Doleschall's name applied to the species so determined by Brauer and von Bergenstamm, of which the genitalia are now figured for the first time.

The Vienna Museum collection contains series named by the same authors as *hügellei,* Schin. and *trentepohlii,* Schin. I cannot trace the publication of either of these names by that author, and if they have ever been published at all they must be attributed to Brauer and Bergenstamm and not to Schiner. The names have probably the same history as *Bengalia fuscipennis, nec.* Macq., (B. & B.), Bezzi, namely that the name is taken from Schiner *in collectione Vindobonensi,* (Bezzi 1913). Thus they are probably not officially 'published' at all, as Bezzi attributes the *Bengalia* to himself, adopting the Brauerian name. The two specimens under *hügellii* are both *dux,* Thos., whilst under *trentepohlii* there stood no less than four species, *viz., melanura,* Meig., *fuscicauda,* Bött., *knabi,* Park. var. *flavipalpis,* nov. and *kempi,* nov. No particular specimen bore any indication that it could be regarded as the type, so it is impossible to use the name even in synonomy, and it had best be dropped altogether.

Patton (1922) has recently drawn attention to some remarkably inaccurate determinations by Brauer in *Musca,* in which he 'lumped'

numerous good species under *domestica*, L. The above recorded mélange is quite as bad. Apart from questions of chaetotaxy, to the use of which Brauer is known to have been scornfully averse (Osten-Sacken, 1903), examination of frontal width and palpal coloration alone should have convinced Brauer and von Bergenstamm that they were dealing with more than one species. Nevertheless, on external characters only I should be very sorry to try and separate a series containing *fuscicauda* and *kempi*, and there is every likelihood that the 'series' in the collections of other European Museums will prove to contain mixtures of species, when such are properly examined, that will make the foregoing example seem quite commonplace.

We see therefore that out of the descriptions of the first period it is possible to adopt with tolerable certainty the names *ruficornis*, *hirtipes* and *aurifrons*. The remaining thirteen names are those of heirotypes, and must be dropped pending elucidation of the latter.

Prior to the examination of the fresh material which forms the foundation of this paper the position of the genus *Sarcophaga* may be tabulated thus :—

	1794-1896	
Described		29
Types female, disregarded	8	
Types destroyed, disregarded	3	
Homonyms, disregarded	2	
Hierotypes, disregarded *pro tem* ..	13	
Recognized	3	29
	1912-1923	
Palearctic species found Oriental	6	
Described	17	23
		52

V THE EXTERNAL CHARACTERS USED IN CLASSIFICATION.

HEAD : The frons in the male is usually narrower than in the female, often considerably so. Its width relative to the eyes is measured for the purposes of this paper by comparing the width at its narrowest, (usually shortly above the antennal roots), with that of an eye at its widest, examining the head directly from in front. Some allowance must be made for individual variation, but species with the frontal width narrow, *i.e.* less than half that of an eye, never vary so much as to bring them into the sections in which the frontal width noticeably surpasses half that of an eye. The frons usually bears a median dark stripe, on either side of which is a paler stripe contiguous to the eye margins, the parafrontals. The proportional width of these stripes is of some value. As might be expected, it is variable.

The antennae provide valuable specific as well as generic characters. In regard to the latter, these lie in the plumosity or pubescence of the arista ; in regard to the former, in the relative proportions of the second and third joints, but here again some allowance has to be made for variation, real or apparent owing to drying, but never, so far as I have

observed, to the extent of more than one length of the second joint either way. The lowest point of the antennae may lie above, or level with, or below the lowest eye-margin, and, owing to the varying length of the second joint, species with the relatively longest third joint may not be those with the antennae attaining the lowest level in regard to the eye.

The chaetotaxy provides the only other characters of value. Examining the head from the front, the VERTICAL bristles consist of one or two pairs situate near the upper interior angles of the eyes. Of these, the interior is always present, the outer, the LATERAL vertical, is always present in the female, of *Sarcophaga* at least, but in the male is usually weaker and often quite absent. Where it is present, but weak, it is sometimes difficult to distinguish from one of the bristles of the occipital row (*q.v.*). The FRONTALS consist of two series, the INTERIOR, a row of bristles along each side of the frontal stripe, more or less reclinate above and crossed below, and extending to shortly below the antennal roots, from the level of which they may be bent outwards towards the eyes, or continue in a line with those above, (sub-genus *Ravinia*). The EXTERIOR frontals are usually wanting in the male, (if present, their presence is generic), and in the female consist of two or three pairs, of which the uppermost is reclinate and the others proclinate, occupying the upper half of the parafrontals. The FACIALS consist of a row on each side along the parafacialia, or stripes continuous with the parafrontals below the antennae, separating the eyes from the true face,—they may be strong or quite absent. The ridges running from the angles of the upper mouth border around the antennae to the frontal lunule are termed the VIBRISSAL RIDGES, and may bear bristles, which are of generic importance. The statement 'ridges bare' is not vitiated by the presence of two or three short bristles immediately above the main mouth vibrissae, for 'ridges bristly' must be understood to mean that the bristles extend to at least half-way between the main vibrissae and the antennal roots.

From the upper mouth-edge, the EPISTOME, there is usually a row of bristles, the PERISTOMALS, along the lowest lateral margin of the head to beneath the lower posterior angle of the eye. These bristles may be long or short, strong or weak, and often change their character four or five spaces from the mouth vibrissae. Between the lowest of the facials and the eye above, the vibrissal ridges in front, and the peristomals below lie the genae, covered more or less with weak bristles or bristly hairs, the GENALS. These may also change their character and colour as they recede from the mouth.

The back of the head, the OCCIPUT, always bears one row of POST-OCULAR CILIA, and amongst the confused mass of bristly hairs usually situate on its disc two interior rows of these may sometimes be made out. Whether an arrangement of bristles here is to be considered as a row is too much a matter of personal opinion to be of very great value. The constant, outer row of bristles is also known as the OCCIPITAL.

THORAX: The chaetotaxy alone is of classificatory importance. The nomenclature of the parts and of their bristles is that used by Williston (1908) in figures 8 and 22 of his work. Of these, the STERNO-

PLEURALS afford characters of generic value. Specifically, the ACROSTICHALS and DORSO-CENTRALS afford the main separatory characters in *Sarcophaga*. The acrostichals appear to be the more constant in arrangement within the species than the dorso-centrals, but it is to the latter that we have to look for the most help. The ACROSTICHALS vary from nil to four presuturally and from nil to two post-suturally, the latter in *Sarcophaga* always prescutellar. The DORSO-CENTRALS appear to be always two presuturally, at least in *Sarcophaga*, but the posterior pairs vary in number from two to five or even six. Unfortunately those nearer the suture are much less strongly developed than those behind, and there may be a good deal of doubt in any case whether a bristle is a definite macrochaete or only part of the common microchaetal covering. Again, if broken off, it is not always easy to distinguish the scar, though sometimes help in the solution of the point may be obtained thus, for a macrochaete, however reduced, leaves a definite scar observable. In cases of doubt, the easiest way is to locate the last two bristles, and mentally divide the distance between them into the distance between the front one and the suture, when it can usually be decided how many more evenly spaced bristles this space will accommodate. A few European species, however, according to Böttcher, have these bristles spaced irregularly, when this course would lead to error. A much more difficult point is the variability of the actual number in the same species. For this reason especially the external characters in *Sarcophaga* never serve to distinguish a species with absolute certainty. In all species of *Sarcophaga* SCUTELLAR APICALS are wanting in the female,—their absence in the male is specific.

ABDOMEN: Here again the valuable characters lie in the macrochaetae. The lateral margins of the segments nearly always bear MARGINAL and often DISCAL (*i.e.* situate towards the middle of the segment) macrochaetae, but the dorsal surface is of more importance. The apparent third segment always bears a pair of median marginals, but the repitition of these, usually in weaker form, on the apparent second segment is of some value. The sternites of the segments bear longish hairs, which vary between being closely appressed to the plates and standing out noticeably.

LEGS: These are very uniform in the female, but bear valuable characters in the male. The mid femur of the latter usually has a fringe of long soft hairs on its lower edge basally, and the bristles of the posterior lower edge are incrassated and placed close to one another, often forming a regular comb. The mid tibia may bear fringes of hairs on its lower anterior and posterior edges. The hind femur, in addition to rows of bristles along its anterior and posterior lower edges, the latter of which is not always present, usually bears a fringe of long soft hairs throughout its lower edge, and if this is strongly developed, the macrochaetal rows may be difficult to make out. The hind tibia may bear fringes of hair on its anterior and posterior lower edges, of which the anterior may be reduced whilst the posterior remains present. It must be borne in mind that the development of these fringes varies greatly with the size of the individual specimen, and whereas they may be prominent features of a large one, they may, especially on the tibiae,

be completely absent in a small one of the same species. Occasionally a species possesses these fringes however reduced in size an individual may be. For this reason, too much value must not be attached to them.

WINGS : These carry few characters. The venation is very constant, and within the genus affords little more than the relative lengths of segments iii and v of the costa. The costal bristle may be present or absent, often in the same species. Vein I sometimes bears bristles, and when this is so, is of use in classification. The value of this is at times, however, only sub-specific. Vein III is always bristly above at least half way to the anterior cross-vein ; below, equally, or on the basal node only.

This assemblage of characters serves well enough to distinguish the genera with which we have to deal in the Orient, but specifically there is little to take hold of. In all but one of the genera the species are few in number, and characters based on colour distinctions and the like serve to separate them, but in the great genus *Sarcophaga* such do not present themselves. The species are singularly uniform in outward appearance. Even *Musca* presents more distinguishing characters. Characters separating groups in the genus can be found in the chaetotaxy and frontal width, but ultimate specific distinctions are often only obtainable on the flimsiest variations, the constancy of which is, specifically, more than suspect. Before Pandellé correlated such with the genitalia even these could not be used, as their changes were quite reasonably suspected to be due to simple variations within the species. Still, now that we have the species securely separated, they are found to be of at least equal value with the characters found in the leg fringes and colour of genital segments, on which in the past reliance was placed with no less unsatisfactory results.

There is nothing then to be done but to turn, as did Pandellé, to the male genitalia, in order to secure certainty of discrimination in *Sarcophaga*. The characters found here, and made use of for specific determinations, are discussed in the next section. As the species of the other genera found in the East are distinguishable without this procedure, only the genitalia in *Sarcophaga* are discussed. There being no object in determination save to provide a basis for other work, there is no object gained by making this process anything but as swift and simple as possible.

VI. THE MALE GENITALIA IN *SARCOPHAGA*.

(Plate XVIII.)

If the whole abdomen of a male *Sarcophaga* be macerated in KOH until all internal organs are dissolved the appearance, viewed ventrally, is that of fig. 1. The true first segment of the abdomen is partially fused with the thorax, and in removing the whole abdomen it will be found that the halteres and their sclerite come away with this segment, showing how complete is the fusion. This segment is membraneous and, as indicated in the figure, bears no spiracles. The tergites of the second and third segments are fused, the line of fusion being indicated by the termination, basally, of the abdominal setae, the membraneous,

basal half being the second, and the chitinized, setose, *apparent first segment* being the third. The conjoint segment bears two pairs of spiracles, conclusively proving its double origin. Further, the sternites are not fused. The fourth and fifth segments call for no comment, but the tergite of the sixth is considerably developed ventro-basally, its margins tucking in beneath the fifth segment's tergite and sternite, thus admitting of an increased amount of play without unduly exposing the connecting membranes. The sixth tergite is normal, and viewed from above, is the apical abdominal segment. Its sternite has undergone entire modification, forming the accessory forceps, between which and the superior claspers the tip of the female abdomen is held during copulation. This space is the genital atrium of Hewitt (1914). The spiracle on the tergite of this segment is the last normally visible. Beyond it lies a domed plate, the tergite of the ninth segment, articulated to which are the bases of the superior claspers, visible along its lower edge, between which is situate the anus. The superior claspers represent the anal cerci on the tenth segment, which has otherwise completely disappeared. The tips of the superior claspers lie beneath and in engagement with the apical lobes of the accessory forceps. The sternite of the ninth segment is not easily recognizable, but is possibly represented by the membraneous flaps connecting the lateral edges of the domed tergite with the basal region of the aedoeagus.

If now the genitalia be extracted, by pulling beneath the superior claspers, the whole apparatus can be drawn out into the position of use. The appearance is now that of figs. 2 and 3, the former drawn somewhat obliquely from above, the latter from the side. By this process another segment becomes visible, the eighth, the sternite of which appears to have completely disappeared, but is probably invaginated to form a membraneous partition overarching the genital atrium and covering the hind gut below. This segment also bears a spiracle, situate much more dorsad than those on segments two to six, which are placed near the ventral margins of the tergites. The genital organ proper hangs down from beneath the ninth segment, filling the gap now found between the superior claspers and the accessory forceps.

Further traction, beyond anything possible by the insect during life, reveals, (fig. 4), a chitinous arch bearing a line of bristles and a spiracle, the position of which is midway on a line joining those of the sixth and eighth segments, thus making the rise in the position of the spiracular openings gradual instead of abrupt. This arch is the remains of the seventh tergite. The sternite of this segment is atrophied on the right side of the abdomen, (viewed from above), but is represented on the left side by a rod arising from the base of the fork of the accessory forceps and joining them to the left hand extremity of the arch of the seventh tergite, (fig. 5). In fig. 6 the sixth and seventh sternites are shown dissected away together.

Before turning to the genital organ itself it will be convenient to discuss this interpretation of the abdominal segments in comparison with earlier ones. Awati (1916) figures, (Pl. xxxviii, figs. 18-20), the arrangement in *Sarcophaga*, but on account of his not reckoning the thoracically fused first segment of the abdomen in his ennumeration his

numbers do not agree with my own. Further, he makes the bar connecting the accessory forceps and the vestigial seventh segment, (which he calls the sixth), the seventh sternite of his account. Following my ennumeration of the segments, this would make it the sternite of the eighth segment, but it is clearly joined to the seventh (Awati's sixth), tergite, and I cannot agree with this hypothesis. As stated above, I consider that the sternite of the eighth segment has been completely invaginated as a peritoneal wall.

This explanation renders unnecessary Awati's hypothesis of the disappearance in Calyptrate Muscoids of his eighth 'pregenital' segment in its entirety, satisfactorily places the seven spiracles, and brings the anus onto the tenth segment, in accordance with the general theory of the number of abdominal urites in insects (Packard, 1909).

Böttcher (1912 b) gives another description, quoting throughout from Pandellé (1896). His description is for purely systematic purposes and he leaves the vexed question of the number of abdominal segments alone. For him there are four main segments and the genital pair[1]. From his account it appears that Pandellé accepted one rudimentary first segment, like Awati, hence his numbers are always one greater than Böttcher's, whereas my own are two greater. In numbering the sternites, however, Pandellé seems to have arrived at the same explanation as myself, for we are agreed in describing the accessory forceps as the sixth sternite, ('6me. plaque',-Pand.). The rudimentary seventh segment was completely overlooked by Böttcher, as was also the fact that the superior claspers are the vestiges of the tenth, as he states that the genital segments, though representing the fusion of "many segments together" are "reduced by fusion to two rings." Böttcher recognized the sternite of the eighth segment in the "weakly membraneous ventral wall of the otherwise strongly chitinized first genital segment," which he states "is hollowed out into a broad longitudinal groove."

Turning now to the genital apparatus itself, the theca, or penis, or aedoeagus hangs down from the dome of the ninth tergite, and reaches far below its lateral limits, as shown in figs. 7 and 8, which are posterior and anterior views respectively. It divides into two portions at a joint 'B', over which there is an inflated membrane, sometimes prominent in uncleared dissections, the sides of which are indicated in figure 7. From the base to this joint is what Böttcher terms the 'haft' of the penis. With its appendages it swings within a chitinous girdle, the 'body of the theca' of Awati and Hewitt, jutting out from the anterior lower lateral edges of the ninth tergite, the homology of which I have not decided upon, whilst no earlier author seems at all clear on the subject. This basal portion of the genital apparatus proper I have termed the shaft of the aedoeagus, following Edwards (1920) in adopting the term 'aedoeagus' in preference to 'theca.'

The shaft of the aedoeagus carries two pairs of appendages, the 'anterior and posterior gonapophyses' of Lowne, ("vorder und hinter

[1] Böttcher calls the genital pair "GS_1" and "GS_2." These convenient abbreviations have been adopted in the keys in this paper.

haken " of Böttcher), which seem best styled by Parker's terms ' anterior and posterior claspers,' which are accordingly adopted here.

So far we have traversed safe and at least partially cleared ground, but on coming to the parts of the aedoeagus itself we reach a state of absolute uncertainty and confusion. Hewitt on *Musca* (1914), Lowne on *Calliphora* (1895), Newstead on *Glossina* (1911) and Böttcher on *Sarcophaga* (1912 b) have all attacked the subject from their own viewpoints. Awati (1916) leaves the subject severely alone, contenting himself with a few remarks culled from earlier writers, none of whom have given a complete account. And, when it comes to attempting to fix a uniform nomenclature which will apply to the changing number and conformation of the parts found throughout even the one genus *Sarcophaga*, I must confess myself completely stultified.

The distal portion of the aedoeagus usually exhibits a pair of posteriorly situate curved appendages, varying in their degree of chitinization and of very variable shape. They may be pointed apically, or blunt, stout or rod-like, simple or complex, free or fused, but except in a comparatively few species they are more or less recognizable, and are usually a prominent feature of the organ. In position they seem to correspond approximately to the ' harpes ' of Newstead, whose term is accordingly adopted,-'h' in figs. 3, 7, 8, 9. In front of these lie a pair of very strongly chitinized rods, part of a girdle of chitin which surrounds the whole aedoeagus which, again following Newstead, are probably to be considered as appendages of the juxta ' J,' and are so figured, ' JA,' in figs. 3, 7, 8, 9, 10. Between the harpe and the juxta lie a shorter pair of chitinized processes, best seen in fig. 10, which represents the aedoeagus viewed from the direction of the arrow in fig. 9. Their homology is more than uncertain, but they are probably equivalent to the ' inmost flaps ' of Böttcher, and may be best styled ' median apophyses,' (figs. 9, 10,-MA). From these appendages, with their subappendages, are apparently developed the varying complex of processes seen in the figures of the various species. To trace their development from species to species is a task beyond the scope of the present paper, and, for any clarity of concept, would necessitate commencing the investigation in a less specialized genus than *Sarcophaga*. Such an investigation the writer hopes to undertake if ever an opportunity presents itself.

The anterior margin of the aedoeagus sometimes bears a more or less membraneous appendage, which is highly developed in the *albiceps*-Group, which is possibly the ' vesica ' of Newstead, whose term is adopted in lieu of a better one, (figs. 3, 8, 9, 11-'V'). It is articulated onto the membraneous area between the arms of the juxta, and is freely moveable thereon ;—(not shown in fig. 10). Probably it contains the actual opening of the ejaculatory duct.

Between the shaft of the aedoeagus and the superior claspers lies on each side a chitinous plate, figured by Awati as an " appendage of the genital segment," and by Parker as the " accessory plate," (" nebenlappen," Bötcher), the second Author's term seeming to me the best, (fig. 3, Ac. Pl.). It is of varying form, often considerably elongated, and in other groups, *e.g. Bengalia*, becomes the ' appendage to the supe-

rior clasper,' and of importance in classification, (Senior-White 1923 a). In such Groups the two plates have doubtless some clasping function, especially in genera such as *Strongyloneura*, (Senior-White 1923 b), where the superior claspers are fused practically throughout their length, but in *Sarcophaga* they are insufficiently developed to so function.

Böttcher divides the aedoeagus, which he calls the ' penis,' into a ' haft,' (stiel), and the ' body of the penis,' which he again separates into a ' middle ' and ' end piece.' According to him the haft consists of a pair of ventral and a dorsal unpaired chitinous plate. In certain species these are indeed strongly chitinized, but in others the paired plates are quite membraneous and are continued as what I have described as the ' inflated membrane ' covering the junction of the shaft with the aedoeagus proper, when only the narrow, rod-like, unpaired dorsal plate supports the shaft. His ' end-piece ' as illustrated for *S. carnaria* appears to correspond roughly to my ' harpe,' whilst his ' lateral ' and ' median flaps ' of the ' mid piece ' would seem to lie in the same position as my juxta and its appendage. Böttcher worked with *carnaria*, whilst I have taken *albiceps*, Meig. as my basic model, hence the impossibility in the present state of our knowledge of obtaining any certainty of agreement in respect of the structures found. I can only admit with Böttcher that the " physiological interpretation of the bewildering complex of moveable articulated arches and plates which the penis of a *Sarcophaga* exhibits is still in darkness."

The superior claspers, though varying greatly in shape, are very uniform in structure. They are more or less fused together along the basal half, but are always completely free apically. Their posterior or lateral margins, sometimes also their anterior, may exhibit a development of spines and bristles and there are often areas of weaker chitinization forming furrows or grooves upon their posterior surface.

The accessory forceps fall into two types, the more common, in which the forked prolongation of the sixth sternite is spined throughout its length on the inner sides, the other, in which a pair of lobes at the apices of the fork alone bear spines, sometimes very reduced. In the *melanura*-Group of the Palearctic Region the whole angle between the arms of the fork is filled up by the hypertrophied marginal spines.

Table I on p. 214 shows the terms used for the same part of the abdomen by the various Authors referred to in this section, so far as I have been able to concord their various writings.

VII. TECHNIQUE.

The examination of the genitalia of a male *Sarcophaga* almost always necessitates the extraction of these organs from their position of repose within the genital atrium. Occasionally a specimen will eject them in its death throes, but this is quite exceptional.

If the specimen is obtained by one having knowledge of the necessity of exposing the genitalia for subsequent determination the method of procedure described by Böttcher (1912 b) should be carried out. This is as follows :—after pinning the specimen should be left until relaxed. The extent of time necessary for this in the Tropics varies so much with conditions of humidity and temperature that no hard and fast rule can

Table I.—*Nomenclature of Parts of male abdomen in Calyptrate Muscoids.*

Segment.	Writer (1923)	Awati (1916).	Hewitt (1914).	Böttcher (1912).	Newstead (1911).	Pandellé (1896).	Lowne (1895).
1st Tergite	Fused with Thorax	Not recognized	....	....	....	....	....
1st Sternite	No Spiracle						
2nd Tergite	Tergites fused, two Spiracles	1st Segment	1st Segment	..	....	1st Segment	....
2nd Sternite							
3rd Tergite	Sternites distinct. Separated	2nd Segment	2nd Segment	1st Segment	....	2nd Segment	....
3rd Sternite							
4th Tergite	Simple	3rd Segment	3rd Segment	2nd Segment	....	3rd Segment	....
4th Sternite							
5th Tergite	Simple	4th Segment	4th Segment	3rd Segment	....	4th Segment	....
5th Sternite							
6th Tergite	Enlarged baso-ventrally.	5th Segment	5th Tergite normal	4th Segment	....	"6 me. plaque."	? 6th Tergite
6th Sternite	Modified to form Accessary Forceps.	Forms Accessary Forceps.	5th Sternite modified to form Primary forceps	5th Sternite	Accessary Forceps		? 6th Sternite
7th Tergite	Rudimentary, a Spiracle.	6th Tergite	6th Tergite reduced.	Not recognized	7th Segment	"7 me plaque."	? Tergite
7th Sternite	Present on left side only as rod joining 6S. to 8T.	7th Sternite	Present on left side only as rod joining to 7T.				Epipleuron
8th Tergite	Present with spiracle	Atrophied	7th Tergite present	1st Genital Segment	8th Segment	"8 me. plaque"	....
8th Sternite	Inarched. Separatting hind gut from genital atrium.	("Pre. genital Segment.")	7th Sternite forms the "secondary Forceps."				
9th Tergite	Present no spiracle	"Genital Segment"	8th Tergite present	2nd Genital Segment	Hypopygium	....	....
9th Sternite	Membraneous walls around base of aedoeagus.		....		Editum		
10th Segment	Atrophied. Except Cerci, forming Superior claspers.	10th Segment	? 8th Sternite	Not recognized, though forceps said to be "articulated" to 2nd genital segment.	Superior claspers	"Mesolobe périnéal"	Anal Cerci
		Anal Cerci					
Genital organ proper	Anterior claspers	Lateral Processes	....	"Vorder Haken"	Inferior claspers	....	Anterior Gonapophysis.
	Posterior claspers		....	"Hinter Haken"		....	Posterior Gonopophysis.
	Chitinous Girdle	Body of the Theca	Body of the penis	....	....	....	....
	Shaft of aedoeagus	....	Theca of penis	Haft of penis	....	....	8th Sternite
	Aedoagus	Theca	....	Mid piece of penis	? Juxta	....	Progenital Sternite
	Harpe	....	....	? End piece of penis	Harpe	....	Paraphallus
	Vesica	....	? Glans penis	Ventral Apophysis	Vesica	....	Hypophallus

be laid down. It will vary from a few hours in hot, dry climates to as much as thirty-six hours in very damp hill localities. The pin is then held in the left hand with its point, (and the ventral surface of the insect) uppermost. The second genital segment, (ninth tergite), is then gripped with the points of a very fine pair of forceps and traction performed. This should be carried out slowly. The superior claspers will then become free. Owing to the amount of crushing that the segment undergoes between the points of the forceps the writer prefers not to complete the operation by their means, but at this point to lay them down and run a mounted needle into the space immediately before them and complete the extraction by pressing this sideways against them. During extraction the motion should be dorsad, (*i.e.* in regard to the insect) as well as posterior-wards.

Usually the aedoeagus withdraws simultaneously from the atrium but if it remains therein it is necessary to insert the point of a needle in front and above and lever it out. To do this with absolute safety it should be done beneath a binocular microscope, but when familiarity with the operation has been attained it can be quite simply performed with a hand lens, running the pin into a piece of cork so as to afford a ventro-lateral view of the insect.

Having extracted the genitalia sufficiently I find it best to lightly nick the edges of the membraneous lateral margins of the first genital segment, (eighth tergite), to prevent subsequent contraction of the parts during drying. Specimens so treated are perfectly determinable without any further manipulation, and the writer greatly hopes that any further collections sent him for determination will be so displayed. If sent in the usual state the labour of dissection is great.

If, however, the specimen has been allowed to become dry with the genitalia retracted, dissection must be resorted to. Böttcher states that it is possible to relax old specimens and carry out the above described procedure, but the method has met with no success at my hands, and is unsafe, owing to the great liability that exists for the abdomen to separate from the thorax when traction is started. In dissection the abdomen should be cut through along the junction of the apparent third and fourth segments. Care should be taken that the line of section is perpendicular to the plane of the abdomen. Otherwise there is great danger that though the cut is in the correct position dorsally it will run more posteriorly ventrally, and damage at least the accessory forceps. This is equally liable to occur if it is attempted to remove a lesser extent of the abdominal tip than that stated. If the specimen is on a single pin and not a card mount the cut is best made with the ventral side of the insect uppermost.

The piece so dissected off should be boiled for a few minutes in 10% KOH, and after cooling sufficiently, dissected under a binocular microscope. A 32 mm. objective and x 2 eye piece, (Leitz), is a convenient power. Both the needles should not be flattened and sharp sided, the one for the left hand is much more preferably blunt. Its function throughout is a steadying one, and if it is very sharp it only penetrates the chitinous plates, and when traction is employed, tears through them.

Placing the left hand needle on the lateral aspect of the apparent fourth segment with the genitalia towards the right, the right hand needle is inserted into the junction of the first and second genital segments and drawn away from the left one. The two genital segments will part from the base of the abdomen at the line of junction of the sixth tergite, taking with them the rudimentary seventh tergite and the accessory forceps. Now completely sever the membrane connecting the two genital segments and again pull them apart. The second, with the aedoeagus, will pull free and is ready for examination. To obtain the accessory forceps the sixth and seventh sternites should be freed from the seventh and eighth tergites, and the seventh sternite cut through just above its junction with the sixth. The chitin of the former is very thick and strong, and a sharp edged needle should be employed. If traction, instead of a cutting motion, results from the attempt, the accessory forceps are very liable to pull in half longitudinally.

Before removing the débris of the operation from the dish it should be noted whether the first genital segment bears strong hind marginal macrochaetae or not. This point is of some diagnostic importance, and the segment becomes greatly damaged in the above described process. If this point is then overlooked the condition of the part in comparing the specimen subsequently with the description of the species indicated cannot be checked.

Determination of the specimen by comparison of the structures found with keys and figures should now be undertaken. If left until the specimen has been dehydrated and cleared it will often be found, specially in insufficiently macerated specimens, that enough elasticity remains in the muscle fibres of the aedoeagus to pull the various parts together. All my figures have been drawn from the organs whilst still in potash. The appearance of the same organ after mounting is often quite different. Differences between the figures of the same species by Böttcher and myself are often due to this. The parts in my specimen were relaxed, in Böttcher's the muscles were contracted. Occasionally advantage may be taken of this subsequent contraction to obtain a posture of the parts corresponding to a figure, thereby rendering an otherwise dubious determination certain.

When done with, the organs should be passed through 50% and absolute alcohol into clove oil, and mounted, the main genitalia in lateral view, the accessory forceps in ventral. For this work I have found the Kodak film method of Edwards (1913) very suitable. The general outline of the genitalia, which is usually quite sufficient for determination of species, can be easily made out from the mount without more manipulation than swinging the celluloid strip sideways on the pin, but if any very detailed examination is required the parts can be floated off the strip in a watch glass of xylol. This is very seldom necessary.

By this method the accumulation of a large number of slides, and the separation of the two parts of one insect in a collection, are avoided.

The whole of the male material, amounting to over fourteen hundred specimens, examined during the preparation of the present paper has had to be dealt with by the foregoing dissection method. With increas-

ing familiarity with the operations involved the writer has been able to deal with an average of six specimens per hour, from dissection to mounting after determination.

VIII. SYSTEMATICS.

i. THE RELATIONSHIPS OF THE SUB-FAMILY.

The arrangement of the various Groups of the *Muscoidea Calyptrata* has been attempted by various Authors in the most diverse ways. The three principal methods are as follows :—

I. Every Group is admitted as a separate family. Under this system the *Calyptrata* fall into five families, *Anthomyidae, Muscidae, Sarcophagidae, Dexiidae* and *Tachinidae.*

II. Only two families are admitted, based on the presence or absence of bristles on the hypopleura. This arrangement splits the *Muscidae* of the first system in half, and the families are usually known as *Anthomyidae* and *Tachinidae* respectively.

III. Only one family, *Muscidae* or *Muscaridae*, is admitted, which not only includes the groups covered by the five families of the first method, but also admits as of equal status all the numerous groups usually accorded family rank among the *Acalyptrata.*

In regard to the first of these methods, whilst it is easy to so define the five families that typical examples fall without a doubt into their correct location, numerous 'border-line' species are found which completely break down the limits of the conceptions as usually defined. Arrangement III suffers similarly, in that all that is gained by it is to reduce the five families of the first method to sub-family rank. Considered from a purely classificatory standpoint no advance is made.

The second method appears to be the most logical, being not only the most suitable for purposes of classification, but also the most correct in respect of phylogeny. There is no doubt that the Acalyptrate Muscoids are simpler and earlier forms than the calyptrates, and whatever decisions are arrived at in respect of the status of their various groups there can be little doubt that their total is of super-family rank as opposed to the total of the *Calyptrata,* and must be accorded entirely separate consideration from the latter, with which alone this paper is concerned.

Taking therefore the five 'families' of the *Calyptrata* as usually defined, we find that they separate into two families which splits the '*Muscidae*' in half, the basal division being the presence or absence of the hypopleural fan of bristles. This division is undoubtedly fundamental, and the old *Muscidae* cannot stand as an entity. The half without the hypopleural fan must be united with the *Anthomyidae,* the half with it being united to the Groups above.

However, the *Anthomyidae* as usually constituted do not seem to be a homogenous Group. The group of genera with the two squamae of unequal size is Muscid in everything but venation, the other, in which both are small and equal, is of Acalyptrate facies. The first

Group contains mainly Saprophages, thus agreeing in habits with the old *Muscidae*, the other includes the various Phytophages which have risen to the status of definite agricultural pests, a distinction that they share with numerous other Acalyptrates but, so far as I am aware, with no member of the higher Muscoids.

It seems possible therefore to commence the arrangement by dividing the old *Anthomyidae* on the types of squamae, placing those genera which have them equal and small into *Acalyptrata* near *Cordyluridae*, (as before stated this paper is not concerned with question of Acalyptrate classification at all), and taking the Group which, in addition to having the alar smaller than the thoracal squama, has a considerable degree of frontal narrowing in the male, into a family also containing the lower half of the old *Muscidae*, which lacks the hypopleural fan. The old division between the two families based on the course of the fourth vein is bridged by such genera as *Spilogaster* and *Stomoxys*, between which there is at most a question of degree in the amount of apical narrowing of the first posterior cell. For this family group the name *Muscidae* can stand, the genus *Musca* (1763) having forty years priority over *Anthomyia*.

Turning now to the groups with hypopleural fan, there is little doubt that their relationships are too close to admit of family rank for all of them. The condition of the arista which is the ultimate criterion of the position of a genus is rendered valueless as a family character by the existence of genera such as *Metallea* and *Metalliopsis*, closely related to one another and obviously belonging to the *Rhiniinae* of the old '*Muscidae*,' which on this test would fall one into *Tachinidae* and the other into *Sarcophagidae*.

None the less, though the principal separatory character thus breaks down, the groups which it was used, (with exceptions), to define are certainly primary. Woefully ignorant though we are of the life history of all but a few species, it may be generalized that the Calliphorine Muscids and the Sarcophagids are Saprophages, the Dexiids and Tachinids parasites. Concerning the *Rhiniinae* our ignorance is the greatest, but the Group so far as we know seems to be divided between parasitism and myrmecophily.

It has too long been the custom to sneer at Robineau-Desvoidy for basing his classification of the Muscoids on their bionomics. Whilst undue stress should not be laid on such, yet, as Osten-Sacken (1903) has pointed out, it is well worth sifting Desvoidy's work for true gold among the dross, and seeing if habits and characters cannot be correlated. The greater bristliness of the two parasitic Groups is very noticeable, and a working separatory character between them and the other Groups is obtainable in the presence of discal macrochaetae on the tergites of the apparent third and previous segments of the abdomen dorsad of the lateral margins.

This will render exceptions only a few Tachinid genera near *Gymnosoma* and it may well be that subsequent research will modify the systematic position of these forms.

What rank then should be accorded to the Groups thus defined? The relationships are too close to admit of the existence of more than

one family, for the existence of discal macrochaetae dorsally on the apparent fourth segment is not even of generic value, (*e.g.* in *Bengalia*), and so their presence or absence on a preceding tergite cannot be paired with their definite presence or absence on an isolated sclerite like the hypopleuron. The Groups therefore must be collected into a single family, to which the oldest included name, *Tachinidae*, must be applied.

In regard to lower divisions, are we to admit *Rhiniinae* and *Calliphorinae*, sub-families of the old *Muscidae*, as equal in rank with our new *Sarcophaginae*, etc., which were once of family dignity ? Hardly so, but it must be remembered that *Tachininae* (of the new arrangement) equally consists of numerous sub-families, and that the probability is that ultimately the concepts *Dexiinae* and *Tachininae* will be restricited to particular Groups, with numerous other sub-families as indicated by Townsend and other Workers, all of which will have equal value with *Rhiniinae* and *Calliphorinae*. For the present therefore it is quite unnecessary to labour this point, and we may now therefore divide the Muscoids according to the following composite table.

1. Squamae equal, small or practically absent ..	ACALYPTRATA.	
Squamae unequal, large and prominent ..	CALYPTRATA	2
2. No hypopleural fan of bristles	Muscidae	3
A fan of bristles on the hypopleura ..	Tachinidae	5
3. Proboscis normal, not formed for biting ..		4
Proboscis elongate, rigid, formed for biting ..	*Stomoxydinae.*	
4. Vein IV running practically straight to wing margin	*Anthomyiinae.*	
Vein IV upturned, nearly closing 1st. posterior cell	*Muscinae.*	
5. No dorsal discal macrochaetae except on 4th. segment		6
Discal macrochaetae dorsally on 3rd and usually on preceding segments		8
6. Epistome prominent, directed downwards or forwards	*Rhiniinae.*	
Epistome not so produced		7
7. Arista plumose practically to tip, usually metallic species	*Calliphorinae*	
Arista usually pubescent, if plumose, only on the basal two-thirds	*Sarcophaginae.*	
8. Arista bare or at most pubescent	*Tachininae, (sens. lat.)*	
Arista plumose, legs usually very elongate ..	*Dexiinae, (sens. lat.)*	

ii. THE GENERA CONSTITUTING THE SUB-FAMILY.

The genera given as belonging to the Sub-family *Sarcophaginae* in the Orient in part II of this paper are those included here by Wulp, (1896), who followed the arrangement of Brauer and von Bergenstamm (1893). It is not proposed to criticize all of the genera therein included, but only those dealt with in Wulp. Such fall naturally into two Groups, those in which the facies is that of a *Sarcophaga*, and those with the metallic appearance of a Calliphorine. The Sub-family may be divided therefore into two sections, *Sarcophaginae verae* and *Sarcophaginae metallicae*, in the same way as the Calliphorines are divided into *Calliphorinae verae* and *Calliphorinae testaceae*. The latter, as I have already shown, (Senior-White 1923 a), is probably not of itself a homogenous Group, but until a comprehensive research into the genera of the whole world is undertaken the point must remain in doubt. The

three Oriental genera of *Sarcophaginae metallicae* are not at all well known, their species all being great rarities, but judging from the descriptions their affinities would seem to be equally well satisfied if placed with the *Calliphorinae*, instead of with the rest of the *Sarcophaginae*. Major Patton agrees with me that *Cynomyia* is a Calliphorine, which was regarded as possible by Williston (1908) who includes the genus in his tables of both *Muscidae* and *Sarcophagidae*. It is the only genus of the three in this section actually known to me, the Indian Museum collection containing an old pair named by Bigot as *Cynomyia violacea*, Macq., without exact locality. These specimens will be referred to in subsequent papers by Major Patton, to whom they have been transferred for his work on the *Calliphorinae verae*.

Catapicephala is a monotypic genus and no specimens of recent date seem to be in existence, but Brauer and von Bergenstamm, (1893) seem to have examined *C. splendens*, Macq., in placing the genus close to *Cynomyia*.

Peckia metallica, Wulp is equally unknown to me, and does not seem to have been considered by Brauer and von Bergenstamm in defining *Phrissopoda*, Macq., in which, contrary to the evidence of chronology, and *teste* Bigot, they sink *Peckia*. Whatever the species may be, its inclusion in an otherwise exclusively Neotropical genus seems doubtfully correct, but, presuming it to be correctly located, there is nothing in Brauer and von Bergenstamm's definition of the genus to prevent an equally suitable position for it in *Calliphorinae testaceae*, as accepted by de Surcouf, (1920), and myself, for all the characters given are found in on or other of the genera of the latter Group.

From the present consideration of the *Sarcophaginae verae* therefore the foregoing three genera are omitted. The obtaining of fresh material, and the investigation of their relationships is necessary before they can be correctly located. Beyond this, before any finality can be looked for, it is clearly essential that both *Calliphorinae* and *Sarcophaginae* should be critically examined with a view to establishing their limits, if indeed such should be found to exist. Probably the two Subfamilies will shade into one another. This investigation, based on the development of the various apophyses of the male genital apparatus, the author hopes to commence in the near future, taking into consideration the genera of the world, as indeed must be essential. This work will necessarily occupy a very long time, and for the present and for our immediate purpose the Sub-family *Sarcophaginae* in the Oriental Region can be divided into genera according to the following key.—

1. Abdomen metallic ; green, blue or black .. 2
   Abdomen grey or yellow with non-metallic dark markings .. 4

SARCOPHAGINAE METALLICAE.

2. Vibrissal ridges bristly to antennal roots *Catapicephala*, Macq.
   Vibrissal ridges not bristly above half-way up .. 3
3. ♂ with 2 exterior frontals ; 2nd abdominal segment with marginal bristles .. .. *Peckia*, R.-D.
   ♂ without exterior frontals ; 2nd abdominal segment without marginal bristles .. .. *Cynomyia*, R.-D.

SARCOPHAGINAE VERAE.

4.	Abdominal markings variable with light incidence	5
	Abdominal markings fixed in position .	6
5.	Arista plumose on basal two-thirds ; sternopleurals 1 : 1 : 1	*Sarcophaga*, Meig.
	Arista pubescent ; sternopleurals 1 : 1 ..	*Sarcophila*, Rond.
6.	Both sexes with external frontals; sternopleurals 2 : 1	*Wohlfartia*, B.& B.
	♂ without external frontals ; sternopleurals 1 : 1	*Agria*, Macq.

The present paper covers the oriental species of the last four genera only.

iii. THE GENUS *Sarcophaga.*

Sarcophaga, Meigen.

Ravinia, R.-D., *Helicobia,* Coquillett, *Böttcheria,* Ald.

Head : Frons narrower in ♂ than in ♀, in neither surpassing an eye width in breadth. Lateral verticals present or absent in the ♂, always present in the ♀. Frontals variable in number, in typical species numerous and closely set. Exterior frontals nil in ♂, three in ♀, the upper one reclinate, the two lower proclinate. Vibrissal ridges bare. Facials varying from weak to strong. Genals usually more or less bristly. Post-ocular cilia in one to three rows, in the former case the occiput with confused mass of black bristles. Antennae with proportion of third joint to second very variable. Arista long plumose on basal two-thirds.

Thorax : acrostichals varying from nil to 5:2 ; dorso-centrals always 2 anteriorly, and from 2 to 6 posteriorly. Scutellum with two marginal, an apical and a preapical pair, the apical always absent in the ♀ , sometime so in the ♂ Pattern always consisting of a median and pair of dorso-central black stripes, of which the first is continued to tip of scutellum.

Abdomen : apparent second segment sometimes, apparent third always with a median pair of marginal bristles, in the ♂ the first genital segment with or without a hind row of strong marginals. Sternite appressedly or outstandingly haired. Pattern consisting usually of a chequered arrangement of black and cinereous patches, varying in position with the light incidence. Exceptionally the apparent second and third segments bear black stripes running straight from margin to margin. In a very few species, (none Oriental), the pattern is quite abnormal.

Legs : in the ♂ the posterior pairs bear various adornments. The mid femora below on apical half has a row of strong short bristles, often closely approximated and thickened and forming a regular comb ; the inner half nearly always with a fringe of long soft hairs. Mid tibiae with or without a fringe of long soft hairs. Hind femora with or without a similar fringe, and with anterior and posterior rows of long macrochaetae below, often hidden in the fringe, and with the posterior pair sometimes wanting. Hind tibiae with inner and outer fringes of long hairs, or the outer or both may be absent.

Wings : a costal bristle present or absent. Vein I bare or bristly. Vein III always bristly as far as at least half-way to anterior cross-

vein. The apex of vein II varying in position, making the proportion of segment iii to segment v of the costa variable.

In offering the following keys to the genus, based on external and genital characters respectively, the variability of the various characters used in the former, as detailed in part V of this paper, and of the impossibility of at present satisfactorily homologizing the various parts of the genital organs, as mentioned in part VI, must be borne in mind.

With regard to the external key, no determination made by its aid alone can be considered trustworthy, even though the description of the complete external characters of the species thus indicated also agrees. It is included more to show the grouping of the species having regard to their external characters, as opposed to that arrived at from genitalia study as indicated in the second table, than to enable a specimen to be actually determined. Even in my own hands I doubt if it would afford more than a 75% degree of accuracy, hence the impossibility of accepting any determinations made by its aid, whether for synonomic, zoogeographical or bionomic purposes.

The small amount of synonomy given applies only to truly Oriental species. The mass of synonomy, still incompletely worked out, which the Palearctic species, including those penetrating the Oriental Region, have accumulated, must be sought for in works relating to the Palearctic Region.

Sarcophaga Meigen.

Based on external characters only, and only applicable to male specimens.

1.	Posterior dorso-centrals 3	2
	Posterior dorso-centrals 4	10
	Posterior dorso-centrals 5-6	29
2.	Acrostichals only present as prescutellars ..	3
	Acrostichals also present presuturally .	7
3.	Segt. iii of costa much shorter than v. Vein I bristly .. . *calicifera*, Bött.	
	Segt. iii of costa equal or longer than v. Vein I bare	4
4.	Frons narrow, less than ½ eye. GS2 black	5
	Frons broader, greater than ½ eye. GS2 variable in colour	6
5.	Hind tibiae fringed .. *josephi*, Bött.	
	Hind tibiae bare .. .. .. *caudagalli*, Bött.	
6.	3rd antennal jt. twice 2nd. Genals black. GS2 black *melanura*, Meig.	
	3rd antennal joint 2½ times 2nd. Genals white. GS2 reddish .. .. .. *falculata*, Pand. var. *persicae*, nov.	
7.	Frons narrow, 3rd antennal joint five times 2nd.	8
	Frons various, 3rd antennal joint not more than twice 2nd	9
8.	Large sp. GS2 black. Wings strongly yellow basally .. .. *flavinervis*, nov.	
	Medium sp. GS2 brown. Humeral and base of 1st basal cell infuscated .. *gravelyi*, nov.	
9.	Frons narrow, scutellar apicals present. GS2 black *aspinata*, nov.	
	Frons broad, scutellar apicals absent. GS2 red .. *haematodes*, Meig.	
10.	Prescutellar acrostichals wanting ..	11
	Prescutellar acrostichals present . ..	12
11.	3rd antennal joint 2½ times 2nd. Appearance normal .. .. *walayari*, nov.	
	3rd antennal joint thrice 2nd. Posterior abdominal segments more or less bright golden .. *aurifrons*, Dol.	
12.	Presutural acrostichals present	13
	Presutural acrostichals absent	22

13.	Presutural acrostichals 4 ..	14
	Presutural acrostichals 1	16
14.	Elongate sp. Face silvery ..	*henryi*, nov.
	Shape normal. Face golden	15
15.	Hind tibiae with strong double fringe ..	*antilope*, Bött.
	Hind tibiae with wide-spaced, sparce but long fringes	*ostindicae*, nov.
16.	3rd antennal joint four times 2nd. Abdominal stripes complete. GS2 red. Mid tibiae fringed	*annandalei*, nov.
	3rd antennal joint not more than thrice 2nd. Pattern of abdomen normal. Mid tibiae bare ..	17
17.	Yellowish-grey sp. Frons, face and genals bright golden. Fringe of hind femora short. GS2 black	18
	Usually darker grey sp. Frons and face at most pale yellowish. GS2 variously coloured ..	19
18.	Palpi black	*knabi*, Park.
	Palpi yellow, at least the tips	*knabi*, Park. var. *flavipalpis*, nov.
19.	Palpi and GS2 black	*albiceps*, Meig.
	Palpi yellow, GS2 variously coloured	20
20.	Mid tibiae fringed	*phoenicopterus*, Bött.
	Mid tibiae bare	21
21.	GS2 red	*hirtipes*, Wd.
	GS2 black	*hirtipes*, Wd. var. *orchidea*, Bött.
22.	3rd antennal joint four times 2nd ..	23
	3rd antennal joint 2½ times 2nd	27
23.	Hind tibiae bare	*tristylata*, Bött.
	Hind tibiae fringed	24
24.	Mid tibiae fringed. GS2 black	*krameri*, Bött.
	Mid tibiae bare. GS2 variously coloured ..	25
25.	Frons broad, $\frac{3}{5}$ eye. GS2 black	*beesoni*, nov.
	Frons narrow, not exceeding ½ eye ..	26
26.	GS2 red	*pattoni*, nov.
	GS2 black	*formosana*, nom. nov.
27.	Mid tibiae fringed ..	*orientalis*, Park.
	Mid tibiae bare	28
28.	Frons very narrow, ⅓ eye, stripe linear. GS2 red	*pusana*, nov.
	Frons broader, $\frac{3}{5}$ eye, stripe broader. GS2 black	*crinita*, Park.
29.	Prescutellar acrostichals present	30
	Prescutellar acrostichals absent ..	40
30.	3rd antennal joint 3—4 times 2nd	31
	3rd antennal joint not exceeding 2½ times 2nd ...	32
31.	3rd antennal joint thrice 2nd, passing lower eye margin; palpi black; 2nd abdominal segment without marginals . ..	*khasiensis*, nov.
	3rd antennal joint four times 2nd, not passing lower eye margin; palpi yellow; 2nd abdominal segment with strong marginals ..	*futilis*, nov.
32.	Hind tibiae well fringed .	33
	Hind tibiae hardly or not at all fringed	38
33.	Mid tibiae fringed. Abdominal stripes complete	*orientaloides*, nov.
	Mid tibiae bare. Abdominal pattern spot-like as usual	34
34.	Antennae yellowish red	*martellata*, nov.
	Antennae black, 3rd joint grey pollinose ..	35
35.	Frons narrow, equal ½ eye	36
	Frons broader, equal ⅔ eye ..	37
36.	2nd abdominal segment usually with marginals; GS2 black	*kempi*, nov.
	2nd abdominal segment bare; GS2 reddish brown	*tsushimae*, nov.
37.	GS2 reddish brown, (occasionally black) ..	*dux*, Thoms.
	GS2 black	*dux*, Thoms. var. *harpax*, Pand.
38.	Antennae red. Mid femoral comb distinct ..	*ruficornis*, Fb.
	Antennae black. Mid femora only with wide spaced bristles	39

39.	Colour dark slaty-grey. Genals black and bristly; GS2 brownish to reddish .. .	*fuscicauda*, Bött.
	Colour yellowish-grey. Genals white and weak: GS2 black ..	*fletcheri*, nov.
40.	Antennae red	*ballardi*, nov.
	Antennae black	*haemorrhoidalis*, Meig.

Sarcophaga Meigen.

Based on the male genitalia. All examinations to be made in profile.

1.	Superior claspers with distinct bristles or spines posteriorly	2
	Superior claspers without bristles posteriorly, *i.e.*, distinct from the shortened hairs of the general covering	15
2.	Superior claspers barely longer than the shaft of the aedoeagus, and with hair tuft in middle of posterior edge	3
	Superior claspers relatively longer, and without such hair tuft	4
3.	Side plate of aedoeagus produced anteriorly on basal half, the lobe rounded or angled ..	*orientalis*, Park.
	Anterior edge of side plate straight, the whole aedoeagus more elongate	*orientaloides*, nov.
4.	A process forming the harpe at lower posterior angle of aedoeagus	5
	Lower posterior angle of aedoeagus evenly rounded	13
5.	Posterior edge of superior claspers sharply angled pre-apically	6
	Posterior edge of superior claspers evenly rounded on apical half	7
6.	Aedoeagus very massive, with sponge-like lobes anteriorly, and on harpe . .	*beesoni*, nov.
	Aedoeagus narrowed basally, side plate triangular, the free angle divaricately incised ..	*phoenicopterus*, Bött.
7.	Anterior edge of superior claspers incurved sharply to tip. A long thread-like process in front of harpe	*ostindicae*, nov.
	Anterior edge of superior claspers running straight to tip	8
	Anterior edge of superior claspers incised preapically	11
8.	Spines of superior claspers strong and prominent	9
	Superior claspers with short serrate bristles only	10
9.	Superior claspers incised on spined area, then sharply angled. Anterior claspers bifid .	*antilope*, Bött.
	Superior claspers with weakly chitinized pre-spinal area. Anterior claspers simple . ..	*flavinervis*, nov.
10.	Aedoeagus with apical lateral rod-like process ..	*aurifrons*, Dol.
	Apical process of aedoeagus not rod-like ..	*khasiensis*, nov.
11.	Superior claspers also spined on anterior margin. Aedoeagus very massive ..	*pattoni*, nov.
	Superior claspers not spined on anterior margin	12
12.	Aedoeagus with basal pincers-like processes and lateral apical rod ..	*ballardi*, nov.
	Aedoeagus with posterior spine and anterior sponge-like lobe	*gravelyi*, nov.
13.	Superior claspers apically truncate, posterior spines short and weak .	*henryi*, nov.
	Superior claspers apically acuminate, posterior spines very strong	14
14.	Apophysis at anterior angle of aedoeagus apically acuminate.	*futilis*, nov.
	Apophysis at anterior apical angle T-shape at tip	*martellata*, nov.
15.	A distinct harpe at posterior angle of aedoeagus	16
	No distinct apophysis functioning as harpe ..	30
16.	A lateral rod-like apophysis arising from base of harpe	17
	No such apophysis	22

17.	Ventral processes as long as harpe, making apex of aedoeagus appear multifid ..	18
	Apex of aedoeagus not so formed ..	19
18.	Aedoeagus with only apical processes ..	*calicifera*, Bött.
	Aedoeagus with ventral basal apophysis ..	*fletcheri*, nov.
19.	Harpe blunt, lateral apophysis clavate ..	*falculata*, Pand.var. *persicae*, nov.
	Harpe cornuate, lateral apophysis narrow ..	20
20.	Lateral and median apophyses sinuate, filiform	*tsushimae*, nov.
	Lateral apophysis rod-like, forked at tip ..	21
21.	Prongs of fork of apophysis elongate, apically rounded	*dux*, Thoms.
	Prongs of fork of apophysis very short and pointed	*dux*, Thoms. var. *harpax*, Pand.
22.	Harpe closely appressed to mid piece of aedoeagus	23
	Harpe not so appressed	24
23.	Superior claspers with posterior edge truncate preapically. Harpe with spine below ..	*ruficornis*, Fb.
	Superior claspers with posterior edge evenly curved. Harpe smooth below	*annandalei*, nov.
24.	Aedoeagus with pedicillate vesica	25
	Aedoeagus without pedicillate vesica	27
25.	Vesica very weakly chitinized, its upper horn more or less straight ..	*knabi*, Park.
	Vesica more strongly chitinized, its upper horn long and curved .	26
26.	Lower half of vesica oblong, longer than the recurved upper horn	*albiceps*, Meig.
	Lower half of vesica small, upper horn longer and less curved	*hirtipes*, Wd.
27.	Median apophyses of aedoeagus noticeably produced	28
	Median apophyses not so produced	29
28.	Harpe apically bifid. Median apophyses lightly clavate	*pusana*, nov.
	Harpe evenly curved to tip. Median apophyses filiform	*crinita*, Park.
29.	Harpe elongate, encircling the other processes of the aedoeagus	*caudagalli*, Bött.
	Harpe short and straight, edge of (?) vesica serrate	*fuscicauda*, Bött.
30.	Aedoeagus with distinct apical process produced anteriorly	31
	Aedoeagus without such process	35
31.	Aedoeagus nearly simple, only one or two short apophyses preapically ..	32
	Aedoeagus of more complicated construction ..	33
32.	Superior claspers of normal shape, with basal hair tuft	*walayari*, nov.
	Superior claspers broad, interiorly weakly chitinized ; no basal hair tuft . ..	*aspinata*, nov.
33.	Aedoeagus with 3 almost equally long processes anteriorly	34
	Aedoeagus not so formed. Superior claspers bilobed on posterior margin ..	*haemorrhoidalis* Meig.
34.	The 3 processes of similar shape	*tristylata*, Bött.
	Basal and apical processes rod-like, the latter upturned ; the median plate-like	*kempi*, nov.
35.	Superior claspers longer than aedoeagus	*melanura*, Meig
	Superior claspers as usual shorter than aedoeagus	36
36.	Posterior claspers serrate on anterior margin. Apex of aedoeagus domed	*haematodes*, Meig.
	Posterior claspers not serrate	37
37.	Aedoeagus with apex curved, an elongate process from its base nearly meeting same ..	*josephi*, Bött.
	Aedoeagus of solid construction	38
38.	Aedoeagus with 2 preapical ventral processes, the longer simple, the shorter bifid	*krameri*, Bött.
	Aedoeagus without noteworthy processes	*formosana*, nom. nov.

Descriptions.

Sarcophaga calicifera Böttcher.

(Plate X, fig. 11)

5 mm. ♂ : *Head* : frons equal to half an eye breadth. No lateral verticals. Frontals very few, not diverging. Facials weak, except lowest. Genals represented by only scattered black bristles. Three rows post-ocular black cilia. Frontal stripe black, fading above to orange. Each parafrontal as broad as this. Parafrontals and face shining silvery. Antennae black, third joint two-and-a-half times the second. Palpi black. *Thorax* : ground colour whitish-grey. Acrostichals 0 : 1, posterior dorso-centrals 3. *Abdomen* : second segment with marginals. Genital segments hidden, the second black. *Legs* : mid femora with some weak bristles arranged comb-like, no basal fringe, only a few long hairs. Mid tibiae bare. Hind femora with fore and hind rows of sparce macrochaetae only. Hind tibiae with about six long fringe hairs towards apex, on inside only. *Wings* : vein I bristly. Costal bristle strong. Segment iii of costa much shorter than segment v.

♀ : frontal width equals that of an eye.

A somewhat isolated species, and apparently the only one in the Orient with vein I bristly. Recorded by Böttcher (1912 d and 1913 e) from Formosa and Colombo. I have seen a specimen from Los Banos, Philippine Ids., (Baker), sent me by Dr. Parker.

The material before me contains specimens as follows :—

Imperial Dept. of Agriculture : Pusa, ♀. vi. 07 ; ♂, viii. 07 ; 1♂, 4♀, 7-12. xii. 22, 'bred in Gastropod.'

Austrian State Museum : Ceylon ; ♂, N.D., (Fischer).

Major Patton colln. Coonoor, 2♂, 2♀, 11. iv. 20, ' bred in meat.'

Sarcophaga josephi Böttcher.

(Plate XVI, fig. 38)

8 mm. ♂ : *Head* : frons equal to two-thirds an eye breadth. No lateral verticals. Frons and face whitish-grey with dark reflections. Antennae black, third joint equal to twice the second. Palpi black. *Thorax* : Acrostichals only distinctly present as prescutellars. Three pairs posterior dorso-centrals. *Abdomen* : second segment without marginals. GS1 grey pollinose, with stronger hind marginals. GS2 black. *Legs* : mid femora with comb of wide spaced bristles. Mid tibiae bare. Hind femora with lower macrochaetal rows. Hind tibiae on the inner side with long and thick but somewhat shorter hairs. *Wings* : vein I bare.

The species is unknown to me, and the foregoing description is that of Böttcher, transposed to deal with the various parts in the same order as in the species more fully described by myself. The species is apparently confined to Formosa.

Sarcophaga caudagalli Böttcher.

(Plate IX, fig. 6)

7 mm. ♂ : *Head* : frontal width two-fifths that of an eye. Frontals hardly diverging. Facials numerous and strong. Genals strong, black. Three rows postocular black cilia. Frontal stripe black, parafrontalia together barely half as wide, these and face dull golden with black reflections above. Antennae black, third joint barely twice as long as second. Palpi black. *Thorax* : ground colour pale yellowish grey. Acrostichals only present as prescutellars. Three pairs posterior dorso-centrals. *Abdomen* : ground colour as thorax. Second segment without marginals. GS2 black. Sternites outstandingly haired. *Legs*: mid femora without comb but with wide-spaced bristles, no fringe. Mid tibiae bare. Hind femora with lower macrochaetal hind row and no fringe. Hind tibiae bare. *Wings* : vein I bare. Costal bristle strong. Segments iii and v of costa sub-equal.

In neither of the specimens seen by me have the sclerites of the aedoeagus taken up the characteristic ' cock's-tail ' appearance to which the species owes its name. This is probably due to potash maceration relaxing them. As will be seen from the figure the sclerites are apparently inserted on a membraneous area, a general contraction of which would pull them into symmetry with the harpe and cause the appearance figured by Böttcher.

Hitherto recorded from Formosa only. The material before me contains the following specimens :—

Austrian State Museum : Ceylon ; ♂, (Felder, 1861).

Major Patton colln. Kotagiri ; ♂, 11. ix. 20.

Authors colln. Ceylon, Pattipola, (6000 ft.) ; 2 ♂, 6. v. 23.

Sarcophaga melanura Meigen.

(Plate VIII, fig. 2)

10-14 mm. ♂ : *Head* : frons equal to an eye breadth. Lateral verticals strongly present. Frontals strongly diverging. Facials weak. Genals black. Three rows post-ocular cilia. Frontal stripe black, parafrontals together rather broader, these and face dull silvery yellowish with darker reflections. Antennae black, third joint twice as long as second. Palpi black. *Thorax* : darkish grey. Acrostichals only present as prescutellars. Three posterior dorso-centrals.

Abdomen : second segment without marginals. GS1 black, with stronger hind marginals. GS2 black. *Legs* : mid femora with fringe and rather widely spaced comb. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae fringed. *Wings* : vein I bare. Costal bristle present. Segment iii of costa longer than v.

With the doubtful exception of *S. josephi*, Bött. this species is the only representative of its group in the Region. According to Böttcher (1912 d) it is common in Formosa. The material before me contains the following specimens :

Indian Museum : Kashmir ; 4 ♂, (Pease, 1915) ; 2♂, Jhelum Valley, Kashmir, 5200, vii-ix. 16, (Pease). Bushire ; ♂, N.D., (Cummings).

Another ♂ without label is on a similar pin to the last, which may be from the same locality.

Cambridge University : Baghdad ; ♂, 29. viii. 20, (Rao).

Austrian State Museum : China ; ♂, N. D., (colln. Winthem), [determined by Brauer and von Bergenstamm as *trentepohlii*, Sch.]. Japan ; ♂, N. D., (Fruhstorfer).

Sarcophaga falculata Pandellé, var. **persicae,** nov.

(Plate XI, fig. 14)

11-14 mm. ♂: *Head* : frontal width equal to three-quarters that of an eye. Lateral verticals wanting. Frontals diverging. Facials very weak, almost absent. Genals white. Frontal stripe dark brown. Parafrontals together twice as wide, these and face dull silvery. One row post-ocular black cilia. Antennae black, third joint two-and-a-half times the second. Palpi black or yellow. *Thorax* : very pale whitish grey. Acrostichals only present as prescutellars. Posterior dorso-centrals three, sometimes only two. *Abdomen* : ground colour as thorax, but except for the median stripe the chequered pattern is brown. Second segment without marginals. GS1 brown, with fairly strong marginals. GS2 red. *Legs* : mid femora with comb and weak fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae with double fringe. *Wings* : first vein bare, costal bristle very weak. Segment iii of costa longer than v.

The above described specimens differ from those of Europe by the development of only two or three posterior dorso-centrals, by the longer third joint of the antennae, and the brown colour of the first genital segment. The frontal stripe is narrower. On these differences I feel compelled to describe the Oriental form as a variety. None the less Böttcher, who records the species from Mussoorie, (1913 d), makes no mention of differences from the European type form, and though it is possible that Himalayan specimens may agree with this, whilst a distinct race inhabits the extreme limits of the Palearctic levels in Mesopotamia and Persia, and reaches to the western half of the Indo-Gangetic plain, it is more probable that further collecting will reveal intermediate forms and so sink my variety. I have seen the European type form from Port Said, (Patton, March 1921), but no Himalayan specimens are before me for comparison with those from Ambala at the foot of the outer ranges.

Dr. Parker has sent me a specimen, belonging to my new form, from Oahu, Hawaii Islands, (Timberlake), which he has determined as *barbata*, Thomson. In this case my variety becomes the type form and Pandellé's species the Palearctic variety, but until Dr. Parker publishes his synonomy and states whether the Thomson type at Stockholm has been examined, I refrain from adopting the name.

The material before me includes :

Indian Museum : Ambala ; 2 ♂ 8-13. v. 05, (Brunetti). Bushire, 2 ♂, N. D. (Cummings).

Cambridge University : Amara ; ♂, 7. vi. 18, (Buxton).

Sarcophaga flavinervis, sp. nov.,(Bigot *ms.*)

(Plate VIII, fig. 4; pl. XVII, figs. 1, 3)

15-16 mm. ♂ : *Head* : frontal width equal to three-fifths that of an eye. Lateral verticals wanting. Frontals diverging. Facials strong. Genals weak and black. Post-ocular cilia irregular. Frontal stripe black, parafrontals together as wide as this. These and face golden. Antennae black, third joint five times as long as second, but not much passing the lower eye margin. Palpi black. *Thorax* : pale yellowish grey. Acrostichals 1:1, posterior dorso-centrals apparently only two pairs, one placed close up to the suture and one median, but the specimens are not in good order, probably there are really three.

Abdomen : rather darker grey than the thorax, second segment bare. GS1 grey pollinose, without marginals. GS2 black. *Legs* : mid femora with comb. Mid tibiae bare. Hind femora with fringe. Hind tibiae double-fringed, neither very long, but the inner rather more so than the outer. The legs in the specimens seen by me are not in good condition. *Wings* : the membrane basally and along costa, and the veins, bright yellow. Vein I bare. No costal bristle. Segment iii of costa longer than v.

♀ : Frons equal to two-thirds an eye breadth. Second abdominal segment with quite strong marginals.

The most striking of the Oriental species known to me. It is one of the very few that can be told at a glance and safely determined from external characters only.

The material before me is as follows :—

Indian Museum : ' India ;'♂, N.D. (250), type. Sadiya ; ♀, N.D., $\frac{5069}{8}$, allotype.

Austrian State Museum : ' E. India,' ♂,♀, (Felder, 1892). Java ; ♂, N.D., (Fruhstorfer).

Sarcophaga gravelyi, sp. nov.

(Plate IX, fig. 5)

11 mm. ♂ : *Head* : frons equal to half an eye width. No lateral verticals. Frontals straight. Facials strong. Genals weak and black. Two rows post-ocular black cilia. Frontal stripe black, parafrontalia together hardly as wide, these and face dirty golden. Antennae black, third joint five times the second. Palpi black. *Thorax* : dark bluish grey. Acrostichals apparently 2 : 1, (the latter very strong). Posterior dorso-centrals 3, all placed on front two-thirds of distance from the suture. *Abdomen* : second segment without marginals. GS2 brown. *Legs* : mid femora with comb and fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row. Hind tibiae double-fringed, that on the inside much the strongest. *Wings* : vein I bare. No costal bristle. Segment iii of costa longer than v. Humeral and inner third of first basal cells infuscated.

The unique type is a ♂ in Major Patton's collection, and bears the label ' Kulla,' 17. v. 20, ' horse or cow.' The name is probably a misspelling of Kallar. I have much pleasure in dedicating the species to

Dr. F. H. Gravely of the Madras Museum, who has done so much to add to our knowledge of the dipterous fauna of South-West India.

Sarcophaga aspinata, sp. nov.

(Plate X, fig. 12.)

5-6 mm. ♂: *Head*: frontal width one-third that of an eye. No. lateral verticals. Frontals diverging. Genals black anteriorly and very strong and bristly. Two rows post-ocular black cilia. Frontal stripe black, indistinctly margined, the parafrontalia together nearly as wide, these and face whitish grey. Antennae black, third joint only as long as second. Palpi yellowish. *Thorax*: ground colour dull dark grey. Acrostichals 1 : 2. Posterior dorso-centrals 3, all very strong. *Abdomen*: second segment without marginals. Genital segments concealed. GS2 black. *Legs*: mid femora without true comb, with only 4-5 small bristles below apically, and basal fringe wanting, in its place about four long, widely spaced bristles only. Mid tibiae bare. Hind femora with a few long bristles, forming the lower rows, no fringe. Hind tibiae bare. *Wings*: vein I bare. Costal bristle present. Segment iii of costa as long as v, or longer. Veins very pale yellow.

♀: Frons equal to three-fifths an eye. Third antennal joint one-and-a-half times as long as the second.

A very isolated species. The very simple construction of the genitalia, as exemplified by the few apophyses of the aedoeagus and the absence of spines along the fork of the accessory forceps, shows relationships with other Groups, notably with the *Rhiniinae* in *Pollenia*, (*c.f.* figs. 7, 8 of Plate IV of my paper 1923 b).

The material before me is :

Imperial Dept. of Agriculture: Coimbatore ; 2 ♂, bred, nos. 428-430, 8. vii. 12, (Fletcher).

Madras Dept. of Agriculture: Coimbatore ; ♂, 30. vii. 115, (Rao), ' bred from stagnant water in manure pit ' : 2 ♂, 1♀, 16-28. viii. 15, (Rao), ' *Parasite on Acrotyla* ', type, allotype and co-type.

Sarcophaga haematodes Meigen.

(Plate XI, fig. 13)

6-7 mm. ♂: *Head*: frons equal four-fifths an eye. No lateral verticals. Frontals quite straight. Facials fairly strong. Genals black, sparce, bristly. Frontal stripe fuscous, the margins indistinct, very broad, the parafrontals together not as wide, these and face dirty whitish yellow. Antennae black, third joint barely twice the second. Palpi black. *Thorax*: pale yellowish grey. Acrostichals 2 : 1. Posterior dorso-centrals 3. Scutellar apicals wanting. *Abdomen*: second segment without marginals, all sternites outstandingly haired. GS1 grey pollinose, with strong marginals. GS2 red. *Legs*: mid femora with comb and a few long basals. Mid tibiae bare. Hind femora with lower hind macrochaetal row, but no fringe. Hind tibiae bare *Wings*: vein I bare. Costal bristle very small. Segment iii of costa not quite as long as v. Veins pale yellowish brown.

The Oriental specimens differ from the European by having the posterior claspers only serrate towards the apex, and the superior claspers with a greater extent black.

Recorded by Böttcher (1913 d) from Mussoorie, this Palearctic species is represented in the material before me by the following specimens:

Imperial Dept. of Agriculture: Simla; ♂, vi. 09, (Howlett).

Indian Museum: Darjiling; ♂, 28. ix. 08, 6000′, sweeping; 8 ♂, 3 ♀, 23-28. v. 10, 7000′; 1 ♂, 1 ♀, 1. xi. 10, (all Brunetti). Naini Tal; 2 ♂, (Lloyd, 1908). Musoorie; ♂, 7. vi. 05, (Brunetti). Kashmir, Jhelum Valley; 5200′, ♂, vii-ix. 16, (Pease). Kogyar; ♂, $\frac{\text{F. S. } 3551}{1834\ \ 10}$ (Yarkand Expedition).

Austrian State Museum: Darjiling; ♀, N. D., (Fruhstorfer).

Sarcophaga walayari, sp. nov.

(Plate X, fig. 9.)

12 mm. ♂: *Head*: frons equal half an eye width. Lateral verticals absent. Frontals strongly diverging. Facials weak. Genals black. Three rows post-ocular black cilia. Frontal stripe black, parafrontals together rather wider, these and face bright golden. Antennae black, third joint equal to two-and-a-half times the second. Palpi black. *Thorax*: pale greyish. No acrostichals. Four posterior dorso-centrals. *Abdomen*: second segment bare. GS2 black. *Legs*: mid femora with comb, interior to which there is a row of rather wide spaced long macrochaetae. Mid tibiae bare. Hind femora with lower hind macrochaetal row and weak fringe. Hind tibiae double-fringed, the inner much the strongest. *Wings*: vein I bare, no costal bristle. Segment iii of costa equal to or rather more than v.

Known only from the unique type, the construction of the aedoeagus is somewhat isolated from other types known to me.

Madras Dept. of Agriculture: Walayar Forests: ♂, 29-30. xi. 19, (Ramakrishna).

Sarcophaga aurifrons Doleschall.

(Plate IX, fig. 8).

10-15 mm. ♂: *Head*: frontal width half that of an eye. Lateral verticals weak or absent. Frontals diverging. Facials strong. Three rows post-ocular black cilia. Genals black and bristly. Frontal stripe black, parafrontals together about as broad, these and face bright golden. Antennae black, third joint barely three times to three-and-a-half times the second. Palpi black. *Thorax*: no acrostichals, not even prescutellars. Posterior dorso-centrals four, the two anterior weak, and there may be an appearance as of five. *Abdomen*: the median stripe is continuous from edge to edge of the anterior segments, the sub-dorsal stripes weak. Most of third and all fourth segment usually covered with bright golden pubescence, sometimes almost wanting. Fourth segment without black markings, or at most with trace of median stripe. Second segment bare. GS1 dark yellowish grey pollinose, without marginals. GS2 shining black. *Legs*: mid femora with comb

and basal fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal rows and fringe. Hind tibiae double-fringed. *Wings*: vein I bare. No costal bristle. Segment iii of costa longer than v.

♀: Frontal width equal to two-thirds an eye. Segment iv of abdomen even more brightly golden than in the male; the gold colour may reach up to the second segment, obliterating the black stripes.

I have given earlier my reasons for identifying this species with Doleschall's description. Save in instances where the gold pile is wanting the species ranks with *flavinervis* as one that may be picked out on sight.

The type locality is Amboina. The material before me contains the following specimens:

Austrian State Museum: Java; Tengger Mts., 4000′, 5 ♂, 2 ♀, (1890): 1 ♂, 1891: Gedeh Mts., 8000′, 1 ♂, viii. 92. Tonkin; 'Manson Mts.,' 2-3000′, 1♂, April-May. All the specimens were taken by Fruhstorfer. Apparently a mountain species.

Sarcophaga henryi, sp. nov.

(Plate VIII, fig. 1.)

13 mm. ♂: *Head*: frontal width equal to half an eye. No lateral verticals. Frontals diverging. Facials strong. Genals white and weak, anteriorly a few black. Three rows irregular post-ocular black cilia. Frontal stripe black, parafrontalia together rather wider. These and face silvery with dark reflections. Antennae black, third joint three-and-a-half times the second. Palpi black. *Thorax*: elongate, clear grey. Acrostichals 4 : 1. Posterior dorso-centrals four. *Abdomen*: elongate, second segment bare. GS2 red. *Legs*: mid femora with comb and weak fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae fringed. *Wings*: vein I bare. No costal bristle. Segment iii of costa longer than v.

The whole figure of the insect is elongate, the abdomen almost cylindrical. Whether the species is related to the elongated Palearctic species of the *dissimilis*-Group seems uncertain. The genitalia show no resemblances. The species is unique in the Oriental Fauna, and its discovery in Colombo, situated on the trade routes between four Continents, makes its original membership of our Fauna doubtful.

The unique type is in the Colombo Museum, a ♂, Colombo, 18. ii. 21. I have much pleasure in dedicating this interesting species to Mr. G. M. Henry, Assistant in Systematic Entomology to the Government of Ceylon.

Sarcophaga antilope Böttcher.

(Plate VIII, fig. 3.)

13-14 mm. ♂: *Head*: frontal width half that of an eye. No lateral verticals. Frontals diverging. Facials weak. Genals black, weak anteriorly, strong posteriorly, where they are white. Three rows post-ocular black cilia. Frontal stripe black, parafrontals together not as wide, these and face pale silvery-golden. Antennae black, third joint three-and-a-half to four times the second. Palpi black. *Thorax*: dark yellowish grey. Acrostichals 4 : 1. Posterior dorso-centrals four

Abdomen : second segment with weak marginals. GS1 dark brown, no marginals. GS2 red. *Legs* : mid femora with comb and weak fringe. Mid tibiae almost bare. Hind femora with lower macrochaetal rows and fringe. Hind femora double fringed. *Wings* : vein I bare. Costal bristle weak or wanting. Segment iii of costa one-and-a-half times v.

Hitherto known only from Formosa ; the material before me contains the following specimens :

Indian Museum : Margherita ; ♂, N. D., $\frac{45}{9}$. Sadiya ; ♂, N. D., $\frac{5071}{8}$ [determined by Bigot as ? *haemorrhoidalis*, Meig.]

Austrian State Museum : ' E. India ;' ♂, 1892, (Felder).

Author's colln. Matale ; ♂, 5. xii. 22, ' at light during heavy rain.'

Sarcophaga ostindicae, sp. nov.

(Plate IX, fig. 7.)

10 mm. ♂ : *Head* : frontal width half that of an eye. (Verticals damaged). Frontals diverging. Facials, the lower very strong. Genals black and bristly. Three rows post-ocular black cilia. Frontal stripe black, broader than both parafrontals together, these and face golden with dark reflections. Antennae black, third joint three-and-a-half times second. Palpi black. *Thorax* : ground colour dark. Acrostichals 4 : 1. Posterior dorso-centrals four. *Abdomen* : second segment bare. GS1 with hind marginals longer but not stronger than other chaetae, dark brownish. GS2 black. *Legs* : mid femora with basal fringe and apical rather wide spaced comb. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae double fringed, the outer consisting of only about four long hairs evenly wide-spaced, towards the middle. *Wings* : vein I bare. Costal bristle very weak. Segment iii of costa equal to segment v.

Austrian State Museum : ' E. India ;' 2 ♂, (Felder, 1892), type and co-type.

Probably Indian. The locality " Ost India " in Felder's 1892 collection includes otherwise only Indian species, *viz.*, *albiceps*, *flavinervis*, and *antilope*. The collection was probably made in Assam.

Sarcophaga annandalei, sp. nov.

(Plate XV, fig. 32, 32*a*.)

10-15 mm. ♂ : *Head* : frontal width three-fifths that of an eye. Lateral verticals weak. Frontals diverging. Facials strong. Genals white and soft. One row post-ocular black cilia, occiput otherwise nearly bare. Frontal stripe black, parafrontals together rather wider, these and face golden. Antennae black, third joint four times the second. Palpi black. *Thorax* : clear grey. Acrostichals 1 : 1. Posterior dorso-centrals four, the two anterior weak. *Abdomen* : stripes continuous. Second segment bare. GS1 yellowish grey pollinose, without marginals. GS2 red. *Legs* : mid femora with comb and fringe. Mid tibiae strongly fringed. Hind femora strongly and hind tibiae double fringed. *Wings* : vein I bare. Costal bristle very weak. Segment iii of costa twice segment v.

♀: Frontal width equal to that of an eye.

The material before me is as follows:

Imperial Dept. of Agriculture: Pusa; 3 ♂, 8-11. iii. 10, 'cage no. III'

Imperial Forest Dept. Dehra Dun; Surajbagh, 4 ♂, 2 ♀, 20. ix. 15, (Chatterjee), 'bred from dead bat.'

Madras Dept. of Agriculture: Coimbatore; ♂, 12. xii. 20, (A.A.), 'on cholam.'

Major Patton's colln. Coonoor; ♂, ♀, 23. iv. 20, 'in decomposing rabbit.'

Author's colln. Matale; ♂, 12. iv. 19, 'on window': ♂, 23. iii. 20, 'on window': ♂, 3. viii. 20, 'on window,' type: ♀, 17. vi. 21, 'on window': 1 ♂, 2 ♀, 8-12. iv. 22, 'bred from *Achatina*', allotype ♂, 16-20. v. 22, 'on window': ♂, 2. vii. 22,' attracted to freshly killed *Achatina*': 5 ♂, 1 ♀, 31. i-17 iii. 22, 'bred in *Achatina*.'

I have much pleasure in dedicating this fine species which, in spite of its wide distribution, seems to be rare in India, to the Director, Zoological Survey of India, in grateful acknowledgment of much kindness and encouragement over several years.

Sarcophaga knabi Parker.

(Plate XII, fig. 19.)

6-12 mm. ♂: *Head*: frontal width three-fifths that of an eye. No lateral verticals. Frontals diverging. Facials weak. Genals bright golden, thickly soft-haired. One row post-ocular cilia. Frontal stripe black, parafrontals together rather wider, these and face pale bright golden. Antennae black, third joint about twice second. Palpi black. *Thorax*: ground colour pale yellowish grey. Acrostichals only distinct as prescutellars, but presuturally they are more or less developed. Posterior dorso-centrals four, the two anterior weak.

Abdomen: ground colour as thorax. Second segment without noticeably stronger hind marginals. GS1 grey pollinose, without stronger marginals. GS2 black, (in one specimen red), both segments with long hairs. *Legs*: mid femora with comb and basal fringe. Mid tibiae bare. Hind femora without lower hind macrochaetal row, with short fringe. Hind tibiae double-fringed, weakly in small specimens. *Wings*: vein I bare. No costal bristle. Segment iii of costa about one-and-a-half times segment v.

♀: Frons slightly exceeding an eye-width.

Recorded by Parker from the Philippines, the material before me includes the following specimens:

Imperial Dept. of Agriculture: Pusa; ♂, 14. vi. 05, (C.S.M.): ♂, 25. x. 05, (C.S.M.): ♂, 10. xi. 06, (B.S.), 'on grass': ♂, 21. ix. 07, (Rashad): ♂, 2. viii. 12, (J.L.M.): ♂, 6. iii. 15, (Md.S.), 'on *Justicia* hedge': ♂, 11. iii. 15, (Md.S.), 'on *Justicia* hedge.' Calcutta; ♂, 1. vi. 09, (C.V.D.Bengal). Sidapur, 3000'; ♂, 13. iii. 17. Dumraon; ♂, 15. ix. 08, (Chatterjee). Rupauli; ♂, 19. iv. 10, (Prasad), 'from bull.'

Imperial Forest Dept. Dehra Dun; ♂, Thano, 21, iv. 14, (Chatterjee), 'hovering round newly felled Sal tree.'

Indian Museum : Calcutta ; ♂, 20. iii. 07. Girnar Mt., (near Junagadh, Kathiawar) ; ♂ ♀ *in cop.*, 2-3. xii. 12, (S.P. Agharkar). Paresnath ; ♂, 13. iv. 09, (Annandale). Ambala, ♂, 8-13. v. 05, (Brunetti). Barkuda Id., ♂, 17. ix. 09, (Brunetti). Port Blair ; ♂, 15. ii. 15. iii. 15, (Kemp). Dibrugarh ; ♂, 17-19. xi. 11, (Kemp, Abor Exped.). Quilon ; ♂, 9. xi. 08, (Annandale). Penang, 2 ♂, 8. viii. 06, (Brunetti).

Madras Dept. of Agriculture : Coimbatore ; ♂, 13. viii. 12, (P.S.N.) : ♂, 20. v. 16, (V.R.), ' on cotton at farm ', Beeravalli, (Bellary Dist.) ; ♂ ♀, 1-4. ii. 13, (C.N.), [det. by Parker.]

Ceylon Agricultural Dept. Peradeniya ; 6 ♂, 15. viii. 22, ' in *Aristolochia ridicula* ' : ♂, 2. iii. 21, (C.S.4803), ' attracted to excrement in field.'

Austrian State Museum : Ceylon ; 3 ♂, (Fischer). Peradeniya , ♂, 4. i. 02, (Uzel). S. India ; ♂, (Fischer). Calcutta ; ♂, $\frac{1690}{6}$, (*ex* Indian Museum). Java ; Buitenzorg, ♂, (Adensamer, 1895). Malacca ; ♂, N.D. Bali ; ♂, N.D., (Fruhstorfer).

Major Patton's colln. : Coonoor ; 2 ♂, 1 ♀, iv. 20, ' bred in human excrement,' [the hind tibial fringe is much longer than usual.] Burliar ; ♂, 20. ix. 20, ' bred in dead rabbit.' Kallar ; ♂, 21. ii. 20 : 2 ♂, 7. iii. 20. Nilambur ; ♂, N.D. Gudalur ; 4 ♂, xii. 20, ' on elephant.' Ahmedabad ; ♂, N.D. Wurrah, (N.S.W.) ; 4 ♂, 10. iv. 20, (Froggatt).

Author's colln. : Matale ; ♂, 3. v. 18 : ♂ ♀, *in cop.*, 1. vii. 19 : ♂ ♀, *in cop.*, 5. vii. 20 ; 3 ♂, 28. vi. 22 : ♂, 2. vii. 22, ' round dead *Achatina*' 2 ♂, 5. vii. 22, ' on lumps of rubber coagulum.' Emelina, (Maskeliya District) ; ♂, 2. v. 19, (Austen), ' on tea.'

Colombo Museum : Anuradhapura ; ♂, 7. xii. 16. Niroddumunai, ♂ ♀ *in cop.*, 10. ii. 14, [the ♂ has GS2 red.]

Sarcophaga knabi Parker var. **flavipalpis,** nov.

Identical with the type form, except that the palpi are yellow, the extent varying from the whole organ to only the tips.

Parker does not recognize this as a separate variety, as I am indebted to him for a pair from Los Banos, Philippines, (Baker), determined by him as his *knabi*, regarding which he states that the palpi are black. I do not consider this variety to be more than a colour form ranking with *ceylonensis*, *luzonensis* and *hutsoni* Park, all of which are sunk in this paper in earlier species, but as the localities recorded below show that its distribution is of a more northerly degree than the type form I record it separately under a varietal name.

Imperial Dept. of Agriculture : Pusa ; ♂, 16. ii. 09, ' on cow dung ' : ♂, 2. viii. 09, (Howlett) : ♂, 7. iii. 07, (M.L.M.), ' on sugar cane ' : ♂, 18. iii. 14, (J.L.M.) : ♂, 6. iii. 15, (Md. S.), ' *on Justicia* hedge ' : 7 ♂, 9-11. iii. 15, (Md.S.), ' *on Justicia* hedge ' : ♂, 26. vii. 15, (Md.S.), ' meat tin no. 4 ' : ♂ ♀, *in cop.*, 29. iii. 21, (S.C.S.) : ♂, 6. vi. 08 : ♂, 31. vii. 15, ' on Aphis on grass.' Chapra ; ♂, N.D., (Mackenzie). Allahabad ; ♂, Kararlabagh, 29. iii. 13, (Howlett), ' on grass.' Balasore ; 2 ♂, 16. x. 14, (A.M.). Bombay ; ♂, 27. iii. 05, Gauhati ; ♂, vi. 21, (Mrs. Fletcher). Abbotabad, 4000 ' ; 2 ♂, 7. x. 22, (Fletcher).

Imperial Forest Dept. : Dehra Dun ; ♂, 7. iii. 18, (Sinha).

Indian Museum: Allahabad; ♂, 16. viii. 09, (Lord). Moulmein; ♂, 6. iii. 08, (Annandale). Kawkareik; ♂, 5. iii. 08, (Annandale). Mergui; 3 ♂, N.D., 5536, 5537, 5525.

Madras Dept. of Agriculture: Coimbatore; ♂, 11. ix. 11, (N.K.M.): ♂, 10. viii. 12, (P.S.), [det. by Parker as *knabi*]. Surat; ♂, 12. vii. 10, (Fletcher).

Austrian State Museum: China; ♂, (Winthem colln.). Java; ♂, (J.47), 2 ♀, (Winthem colln.), [detd. as *taenionota*, Wd.).

Author's colln. Banhar; ♂, 2 ♀, 13. iv. 21, (Inglis), type and allotype.

Sarcophaga albiceps Meigen.

(Plate XII, fig. 18, 18*a*).

8-14 mm. ♂: *Head*: frons equal to three-fifths of an eye-width. Lateral verticals wanting. Frontals nearly straight. Facials weak. Genals golden. Post-ocular cilia, except outer row, irregular. Frontal stripe black, parafrontals together not as wide, these and face strongly or slightly golden, the frons with black reflections. Antennae black, third joint two-and-a-half to three times the second. Palpi black. *Thorax*: ground colour dark grey. Acrostichals 1 : 1. Posterior dorsocentrals four. *Abdomen*: second segment bare. GS1 black, no marginals. GS2 black, exceptionally red. *Legs*: mid femora with comb and long basal fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae double-fringed. *Wings*: vein I bare. No costal bristle. Segment iii of costa twice v.

♀: frontal width equal that of an eye.

Widely distributed in the Palearctic Region, including 'Turkomania' and North-East Africa. Recorded by Böttcher from 'German' East Africa; also from North India, Colombo, Hong Kong and Formosa in the Oriental Region, and from New Guinea in the Australian. The material before me includes:

Imperial Dept. of Agriculture: Pusa; ♂, 14. vi. 05, (C.S.M.): 2 ♂, 26. iii. 06, (Lefroy): ♂, 4. iv. 06, (D.R.), 'on mulberry': ♂, 20. ix. 06: 2 ♂, 6. iii. 07, (M.L.M.): ♂, 20, ii. 07, (M.L.M.), 'on grass': ♂, 25. ii. 07, (M.L.M.), 'on sugar cane': ♂, iii. 07, (M.L.M.), 'on sugar cane': 2 ♂, 24. iii. 08, (Kar): ♂, 18. xii. 12, (H.S.): ♂, 11. iii. 13, (P.S.S.): ♂, 7. xi. 13, (Md.S.): ♂, 17. iii. 14, (J.L.M.): 12 ♂, 6-12. iii. 15, (Md.S.), 'on *Justicia* hedge': 2 ♂, 1 ♀, (? in) calf dung, 9-12. iii. 18; ♂, 24. viii. 20, (Austen): ♂, 28. iii. 21, (S.C.S.): ♂, 9. iii. 21, (Fletcher): ♂, N.D., in fly trap: ♂, 12, ii. 16: ♂, 28. xi. 22, 'on horse dung,' (Sen); ♂ ♀, *in cop.*, 14. i. 23, (Fletcher). Laheeria Serai; 2 ♂, 1 ♀, 13. ii. 12, 'Vety. Hospital, on wound of a bull.' Sidapur; 3000ft.; 2 ♂, 1-2. iv. 17; Burdwan; ♂, ii. 06, (A.W.). Maymyo, 3,500ft.; ♂, 19-21. viii. 14, (Fletcher). Bhagalpur; ♂, 1. x. 08. Dharahra; ♂, 25. vii. 09. Madras; ♂, 3. xii. 22, (Isaac), 'in bazaar.' Allahabad; ♂, 20. ii. 13, (Howlett), 'on grass, Kararlabagh.' Gauhati; ♂, 24-31. xii. 22, (Fletcher): ♂ ♀ *in cop.*, 28. xii. 22, (Fletcher), 'on human excrement.' Delhi; ♂, 20. iii. 13, (Howlett), 'sweeping grass.' Lahore; ♂, 16-17. x. 22, (Dutt). Kathgodam; ♂, 3. ix. 13, (J.L.M.). Abbo-

tabad ; ♂, 7. x. 22, (Fletcher). Dacca, ♂, xii. 11, (Sen). Bombay ; ♂, 27. iii. 05 : ♂, 25. iii. 05, ' on hills, Kurla ': ♂, 7. iii. 05, ' Parel.' Coonoor ; ♂, 28. ii. 20, (Fletcher) : 5 ♂, 23. viii. 22, (Isaac). Kodaikanal : 2 ♂, viii. 21, (Fletcher) : 2 ♂, 6. ix. 21, (Fletcher), ' attracted to human excreta.'

Imperial Forest Dept. Dehra Dun ; ♂, iii. 18 : ♂, ix. 18.

Indian Museum : Calcutta ; ♂, 25. ix. 04, (Brunetti) : ♂, 26. ix. 04, (Brunetti) : ♂, 15. i. 07, (Brunetti) : ♂, 9. iii. 07 : ♂, 11. iii. 07 : 3 ♂, 20, iii. 07 : ♂, 8. iv. 07 : 2 ♂, 10-11. iv. 07 : ♂, 23. iv. 07 : ♂, 9 : viii. 07 : ♂, 1. x. 07 : ♂, 19. ii. 15 : 3 ♂, N. D. $\frac{2679}{11}$, $\frac{6934}{14}$, $\frac{6939}{14}$, ♂. N.D., $^{1}\frac{436}{8}$ [determined by Bigot as ? *tenuipalpis*, Macq.]. Darjiling ; ♂, 22. ix. 08, (Brunetti) : ♂, 24. ix. 08, (Brunetti), ' sweeping grass.' Kurseong ; ♂, 9. ix. 09, (Annandale). Medha, (Satara Dist.); ♂, 22-25. x. 12, (S.P.A.). Kulu ; ♂, $\frac{7131}{14}$ N.D., [determined as *princeps*, Wd.]. Kalimpong ; 2 ♂, 24. iv-10. v. 15, (Gravely), 600-4500 ft. Sikkim ; ♂, N.D., (de Nicéville). Butal, (Nepal) ; ♂, 12. i. 08. Muttra ; ♂, 22. iv. 06, (Brunetti), Ambala ; 2 ♂, 8-13. v. 05, (Brunetti), [GS2 red in both specimens.] Mergui ; ♂, N .D., $\frac{5534}{10}$.

Madras Dept. of Agriculture : Coimbatore ; ♂, 17. v. 14. (Ponniah), [GS2 red] : ♂, 10. vii. 17, (Student colln.), ' preying on ant pupae ': ♂, 20. viii. 07, (C.V.R.), [GS2 red] : ♂, 17. x. 17, ' in insectary.' Calicut ; ♂, 20. v. 20. Chikballiapur, (Mysore); ♂, 19. i. 14. ii. 15. Hagari ; ♂, N.D., ' parasite on *Nonagria* on maize,' (Y.R.), [GS2 red]. Coonoor ; ♂, 6-13. v. 19, (Nathan). Ootacamund ; ♂, 1. vi. 13, (Y.R.). Palney Hills, 3000-6000′; ♂, 10-21. v. 17, (Nathan). Shevaroy Hills, 4500′ ; ♂, 21. iv.-4. v. 13, (Y.R.). Bababuddin Hills, 4-5000′ ; ♂, 2-12. xi. 12, (Fletcher), ' in privy ': ♂, 2-12. xi. 12, (Fletcher), ' on human ordure.'

Ceylon Agricultural Dept : Peradeniya ; 2 ♂, in *Aristolochia* flowers, 15. viii. 22.

Austrian State Museum : Calcutta ; ♂, $\frac{1685}{6}$, (Indian Museum specimen.) ' E. India'; 2 ♂, (Felder, 1892). Java ; Tengger Mts., 4000′, 2 ♂, (Fruhstorfer, 1890) : 2 ♂, N.D., (Fruhstorfer) : ♂, 1895, (Adensamer). Lombok ; ♂, Sambalun, 4000′, iv. 96, (Fruhstorfer). Tonkin ; ♂, Manson Mts.2-3000′, iv-v., (Fruhstorfer).

Major Patton's colln. Coonoor ; 57 ♂, 65 ♀, 28. iv-1. v. 20, ' bred in human excrement ': 6 ♂, 16 ♀, 11. iv. 20, ' bred in meat.' Kallar ; 3 ♂, 7. ii. 20 : ♂, 25. ii. 20 : ♂, 29. ii. 20 : ♂, 27. ii. 20, ' on human excrement ': ♂, 9. iii. 20 : 6 ♂, 7 iii. 20. Kotagiri ; ♂, 7. xi. 20 : 5 ♂, 11. xi. 20 : ♂, x. 20. Benhope ; ♂, 7. i. 20, on cow dung.' Madras ; 2 ♂, ii. 21, ' around Harbour.' Gudalur ; 4 ♂, xii. 20, ' on elephant.' Burliar ; ♂♀, 20. ix. 20, ' bred in decomposing rabbit.' Mungpu, (Darjiling Dist.) ; ♂, 1. xii. 20, 3800′

Author's colln. : Matale ; ♂, 26. ix. 19 : ♂, 1. x. 19 : ♂, 19. iv. 22 : ♂, 25. vi. 22 : ♂, 29. vi. 22, ' on decaying *Achatina*': 2 ♂, 5. vii. 22., ' on lump of rubber coagulum.' Pusa ; ♂ ♀, *in cop.*, 24. 11. 21. Banhar, 26. vii. 22, (Inglis). Shillong , ♂, 12. x. 20. Cherrapunji, ♂, 18. x. 20. Nalanda ; ♂, 17. i. 23, ' at decaying *Achatina*.'

Sarcophaga phoenicopterus Böttcher.

(Plate XVI, fig. 39, 39*a*.)

17 mm. ♂: *Head*: frontal width half that of an eye. Lateral verticals scarcely present. Facials thin, but fairly long. Genals black. Occiput with fawn hairs which also extend onto genae. Frontal stripe brownish-black, the parafrontalia together about as wide, these and face yellow. Antennae black, third joint only as long as second, but reaching to level of lower eye margin. Palpi thin, black. *Thorax*: Acrostichals only present as prescutellars. Posterior dorso-centrals four or five, of which the two or three anterior pairs are weak. *Abdomen*: second segment bare. GS1 grey pollinose, without hind marginals, GS2 shining black. *Legs*: mid femora with strong macrochaetae forming a wide-spaced comb. Mid tibiae fringed. Hind femora thickly fringed, in which the equally long but weak bristles of the lower macrochaetal rows are almost hidden. Hind tibiae double-fringed. *Wings*: vein I bare. No costal bristle.

♀: frontal width two-thirds that of an eye. (The identity of the ♂ with the ♀ is not certain).

Recorded from Formosa only. Böttcher states that the shape of the superior claspers resembles that of some Neotropical forms, but no Oriental or Palearctic species.

Sarcophaga hirtipes Wiedemann.

(*Sarcophaga rufipes*, Wied.)

7-12 mm. ♂: *Head*: frontal width equal to four-fifths that of an eye. Lateral verticals present. Lower frontals straight. Facials weak. Genals sparce, yellowish white. One row post-ocular black cilia. Frontal stripe black, occasionally brownish, the parafrontals together hardly twice as wide, these and face golden, the former with dark reflections. Antennae black, the tip of second joint sometimes reddish brown. Third joint rather more than twice second. Palpi yellow. *Thorax*: ground colour pale whitish grey. Acrostichals 1 : 1, the presutural one not very distinct. Posterior dorso-centrals four, only the two posterior pairs prominent. *Abdomen*: ground colour as thorax. Second segment with median hind marginals, often very weak. GS1 grey pollinose, GS2 red. *Legs*: mid femora with comb and some sparce basal fringing. Mid tibiae fringed apically in large specimens only. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae double fringed. *Wings*: vein I bare. Costal bristle present but small. Segment iii of costa longer than v.

The *rufipes* form is very pale with brown legs.

Only recorded in the Orient from Deesa on a specimen determined without genitalia examination. The species is really Southern Palearctic and North African. Böttcher records it from North Africa and Asia Minor, whilst I have a specimen from the Gold Coast, (Northern Territories), collected by Dr. J. J. Simpson, sent me by Dr. Parker.

The material before me includes the following specimens;

Imperial Dept. of Agriculture : Dharwar ; ♂, 5. iii. 13. Ludhiana ; ♂, 26. vii. 09 : ♂, 11. viii. 09. Coimbatore ; 3 ♂, 6 ♀, iii. 10. (M.S.), 'bred in melons.'

Indian Museum : Baroda ; ♂, 25. viii. 12, (S.P.A.).

Madras Dept. of Agriculture : Coimbatore ; ♀, 2. vii. 12 : ♀, 12. [Both determined by Parker.]

Cambridge University : Baghdad ; ♂ ♀ *in cop.* 10. viii. 20, (Y.R.R.). Amara ; ♂, 30. x. 17, (Buxton) : ♂, 30. iii. 18, (Buxton).

Major Patton's colln. : Ahmedabad ; 5 ♂, N.D. Ajmere ; 2 ♂, N.D. Delhi ; 3 , N.D.

Sarcophaga hirtipes Wiedemann var. **orchidea** Böttcher.

(Plate XII, fig. 17.)

♂: Differs from the type form as follows : Lateral verticals wanting. Palpi normally yellow, occasionally black. Frons and face silvery white. GS2 black.

♀: Frontal width exceeding that of an eye. Second abdominal segment without hind marginal bristles.

Originally described from Formosa, Böttcher records it from Calcutta, Colombo and New Guinea. I am indebted to Dr. Parker for a pair from Baguio, Benguet, Philippine Ids., (Baker).

Böttcher (1913 d and e) regards *hirtipes*, Wd. as a variety of *albiceps*, Meig., and his own *orchidea* as a distinct species. After examining long series of *albiceps* and *orchidea*, and some material of *hirtipes*, I have come to the opinion that *hirtipes* is more closely related to *orchidea* than it is to *albiceps*. The lower half of the vesica is much more in agreement whilst the upper horn is far more elongate and less recurved than in Meigen's species. There is a considerable difference between the accessory forceps of *albiceps* and *orchidea*, which in the latter have the basal angle rounded and the spines much weaker than in the former, and the forceps of *hirtipes* agree in this respect with Böttcher's species. The lateral bristles prominent on the superior claspers of *albiceps*, in posterior view, are wanting in *hirtipes* and in *orchidea*, whilst both the latter have the palpi yellow, a character I have never seen in *albiceps*. Taking these points into consideration I consider that *hirtipes* is distinct from *albiceps*, but not from *orchidea*, which latter however is a valid subspecies. Wiedemann's name, of course, applies with Böttcher's as that of the subspecies.

Here, as in several other cases, we seem to see evolution still in progress, as Böttcher, (1912 a) points out. The amount of elongation in the horn of the vesica varies between typical *hirtipes* and var. *orchidea* to some extent. We do not yet know the function of any part of the aedoeagus in the copulatory act, but it is easy to believe that material alterations in the length of any part would soon inhibit interbreeding. That the horn of the vesica is a flexible structure must none the less be borne in mind. Breeding experiments in the few areas where *hirtipes* and *orchidea* both occur can alone settle the status of these two forms.

The material before me includes :

Imperial Dept. of Agriculture : Pusa ; ♂, 3. iii. 05 : ♂, 5. xii. 05 : ♂, 21. ix. 06 : ♂, 21. ii. 06 : ♂, 4. xi. 06 : ♂, 6. iii. 07 : ♂, 25. ii. 07 : ♂

4. iii. 07, ' on sugar cane ': ♂, 26. ii. 07 : ♂, 15. viii. 08 : 2 ♂,2♀, 15. xi. 08, (Howlett), ' about dung ': ♂, 14. xi. 14 : 11 ♂, 6-18. iii. 15, (Md.S.), ' on *Justicia* hedge.' ♂, 19. x. 10, (S.S.), ' in jungle ': ♂, 24. vii. 15. ' no. 3 tin ': ♂, 24. viii. 20, (Austen) : ♂, 27. viii. 17, (Fletcher) : ♂, 21. ix. 06, (B.B.) : ♂, 20. ix. 15 : ♂, 23. vii. 15 : ♂, 10. ix. 15, ' at light.' *Larpur* ; ♂, N.D., (Vety. Asst.). Purneah ; ♂, 9. x. 09, ' bullocks.' Palamau ; ♂, vi. 08, (Vety. Asst.). Hopin, (Upper Burma) ; ♂, 18-20. viii. 14, (Fletcher). Dumraon ; ♂, 31. vii. 09, Supaha ; ♂, 18. iv. 10, (Prasad), ' from buffalo.' Port Canning ; ♂, 24. xii. 07, (Howlett), ' on *Euphorbia.*' Gauhati ; 2 ♂, 27. xii. 22, (Fletcher), ' at human excrement.' Dacca ; ♂, 16. i. 06 : ♂, xi. 11, (Sen), ' on cow ': ♂, xii. 11, (Sen), ' sweeping.' Bombay ; Parel, ♂. 7 iii. 05, Rohtak ; ♂, viii. 09, (Dutta, no. 16). Abbotabad ; 11 ♂, 7. x. 22, (Fletcher), ' on cow dung.'

Imperial Fors' Dept : Dehra Dun ; ♂,19. ii, 18, (Bose),

Indian Museum : Calcutta ; ♂, 10. v. 04 : 2 ♂, 26. vii. 04 : ♂. 18. ii. 05 : ♂, 20. i. 07 : ♂, 26. ix. 04 : (all foregoing Brunetti) : ♂, 20. iii. 07 : 2 ♂, 4. ix. 07 : ♂, 14. v. 07 : ♂, 29. v. 08, (Annandale) : ♂, 'Majherat,' 5. ix. 09, (J.B.R.). Bandel ; ♂, 5. viii. 08, (Paiva). Khoolna ; ♂, 9. vii. 07, (Caunter). Jalpaiguri ; 3 ♂, 1 ♀, vii. 19, ' passed by patient in hospital,' (Lloyd), 2 ♂, 1 ♀ have the palpi black. Sylhet ; ♂, 28. xi. 05, (Hall). Barkuda Id.; ♂, 3-19. viii. 19, (Gravely). Port Blair ; ♂, 15. ii.-15. iii. 15, (Kemp). Rangoon ; ♂, 18. viii. 06, (Brunetti). Mergui, ♂, $\frac{5551}{10}$. Mahableshwar ; ♂, 13-16. iv. 12, (Gravely).

Madras Dept. of Agriculture : Coimbatore ; ♂, N.D. : ♂, 12. viii. 12 : ♂, 21. vi. 12 : ♂, 5. ii. 12, (Fletcher) : ♂, 10. viii. 17 : ♂, 7. xii. 18 : ♂, 23. v. 19 : 3 ♂, 25. vii. 20 : ♂, 7. xii. 20, ' bred from night soil ': ♂, 10. xii. 20 : ♀ , 15. viii. 12, determined by Parker. Bhimarvaram, (Kistna District) ; ♂, 25. vi. 17, (Isaac). Thamarassai, (South Malabar) ♂, 11. vi. 16, (Isaac). Ramnad, Nathampatti ; ♂, 15-22. xi. 12, determined by Parker. Bababuddin Hills, 4-5000′; ♂, N.D., (Fletcher), ' on human ordure.'

Ceylon Agricultural Dept. : Peradeniya ; 4 ♂, 2. iii. 21, (c.s.4803), ' attracted to excrement in field ': ♂, 15. viii. 22, ' in *Aristolochia ridicula.*'

Austrian State Museum : Calcutta ; 2 ♂, $\frac{1471}{6}$, $\frac{1574}{6}$ (ex Indian Museum), the latter is labelled by Böttcher ' co-type '. S. India ; ♂ : N.D., (Fischer). Lombok ; ♂, Sambalun, 4000′, iv. 96, (Fruhstorfer), Sapit, 2000′, ♂, iv. 96, (Fruhstorfer).

Major Patton's colln. : Gudalur ; ♂, xii. 20, ' on elephant ', palpi black. Mangalore ; ♂, xii. 20. Kallar ; ♂, 15. ii. 20, ' human excrement ': 8 ♂, 7. iii. 20. Coonoor ; ♂ ♀, 9. iii. 20. Ahmedabad ; ♂, N.D. Delhi ; ♂, N.D.

Author's colln. : Matale ; ♂, 11. iv. 19, ' among grass ': 2 ♂, 18. xii. 22, ' artificially bred in *Achatina* '. Nalanda ; ♂, 17. i. 23, ' attracted to decaying *Achatina.*'

Colombo Museum : Colombo ; ♂, 16. vi. 14.

Sarcophaga tristylata Böttcher.

(Plate XVI, fig. 37.)

10-14 mm. ♂ : *Head* : frontal width one-third to two-fifths that of an eye. Lateral verticals sometimes present, but never strong. Facials weak. Parafrontalia and face yellowish. Antennae, third joint two-and-a-half times the second. Palpi black. *Thorax* : acrostichals only present as prescutellars. Posterior dorso-centrals four, the two anterior weak. *Abdomen* : second segment bare. GS1 grey pollinose, without stronger hind marginals. GS2 black. *Legs* : Mid femora with strong comb. Mid tibiae bare. Hind femora with lower row of strong macrochaetae. Hind tibiae bare, only on the inner side with sparce long hairs. *Wings* : vein I bare.

Only known from Formosa. Böttcher points out that the copulatory organs point to close relationship with *aratrix*, Pand. I cannot see this from his figure of that species, but the relationship with *beckeri*, Villen. appears to be very close, judging from Böttcher's figure of the latter.

The species is unknown to me, and the foregoing description is compiled from Böttcher's comminuted one.

Sarcophaga krameri Böttcher.

(Plate XVI, fig. 35.)

10-15 mm. ♂ : *Head* : frous from one-third to two-fifths an eye width. Lateral verticals weak or absent. Facials weak. Antennae black, third joint more than thrice second. Palpi black. *Thorax* : acrostichals only present as prescutellars. Posterior dorso-centrals four, the two anterior weak. *Abdomen* : second segment exceptionally only with marginals. GS1 grey pollinose, without stronger hind marginals. GS2 black. *Legs* : mid femora with a strong comb, and strong basal fringe. Mid tibiae fringed, weakly in small specimens. Hind femora well fringed. Hind tibiae double fringed. *Wings* : vein I bare.

The foregoing description is built up from Böttcher's partially tabulated one.

Described from Formosa, Böttcher (1913 e) subsequently recorded it from Singapore. In the same paper he described what he considered to be the female of this species from Formosa and Colombo material, but failing the obtaining of a pair *in cop.* he was, of course, uncertain of identity. His description of his supposed female states that the head and thorax resemble the male except in the regular sexual differences, but the construction of the genital opening is so different from all other females that this species is easier to recognize in that sex than in the male. He states that " the black, brownish-grey dusted first genital segment is exceptionally outstanding, posteriorly transversely truncate without dorsal marginal bristling. The sagittally placed genital cleft has the form of a horse shoe with the curve dorsally directed, and is furnished, ring-like, with strong macrochaetae also in the middle of the dorsal margin, of which the bristle-margin in most *Sarcophaga* females lies free. The horse shoe-like opening and its ventrally parallel margined continuation becomes through the last ventral plate, relative-

ly to the last genital segment, chiefly outstanding, so that sometimes only a frontal cleft lies free."

In the Austrian State Museum there is a ♀ from Malacca, without further data, determined with a query as this species by Böttcher. The peculiar genital aperture accords well with Böttcher's description.

Sarcophaga beesoni, sp. nov.

(Plate XIV, fig. 28.)

13 mm. ♂ : *Head* : frontal width three-fifths that of an eye. Lateral verticals wanting. Frontals straight. Facials strong. Genals sparce, black. Three rows post-ocular black cilia. Frontal stripe black, parafrontalia together about as broad, these and face dirty golden. Antennae black, third joint four times second. Palpi black. *Thorax* : dark grey-blue. Acrostichals only present as prescutellars. Four posterior dorso-centrals. *Abdomen* : second segment without marginals. GS2 black. *Legs* : mid femora with comb and weak basal fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae fringed on both sides. *Wings* : vein I bare. No costal bristle. Segment iii of costa longer than v.

The construction of the male genitalia in this species differs widely from all others known to me. *S. gravelyi*, nov. and *S. pattoni*, nov. show the development of one such ' sponge-like lobe ' on each side of the tip of the aedoeagus, and probably the marginal serrations of the part I have doubtfully described as the vesica in *S. fuscicauda*, Bött. are of similar organization, but *S. pattoni* alone shows any (*essential* similarity of construction. The type of the present species is unique, and its elucidation must await the receipt of further specimens. Owing to the very inaccessible locality from which the type came, these are likely to be long before they are forthcoming.

In the Imperial Forest Dept. colln., 1 ♂, Mohnyin, (Upper Burma), 23. v. 19, (Beeson).

Sarcophaga pattoni, p. nov.

(Plate X, fig. 10.)

13 mm. ♂ : *Head* : frontal width equal to half an eye. No lateral verticals. Frontals diverging. Facials strong. Genals thin, black anteriorly and white posteriorly. Three rows post-ocular black cilia. Frontal stripe black. Parafrontalia together not as broad, these and face white with black reflections. Antennae black, third joint four times second. Palpi black. *Thorax* : dark bluish grey. Acrostichals 0 : 2. Posterior dorso-centrals four. *Abdomen* : second segment bare. A trace of red on hind margin of apparent fourth. GS1 yellow pollinose. GS2 red. *Legs* : mid femora with comb and basal fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae with double fringe. *Wings* : vein I bare. No costal bristle. Segment iii of costa longer than v.

♀ : Frontal width two-thirds that of an eye.

For remarks on the construction of the genitalia *vide S. beesoni*, nov. At first glance the organ at the upper anterior angle of the aedoeagus

looks like the vesica of the *albiceps*-Group, but this is very uncertain. There is an arrangement of hook-like processes in the same position in *beesoni* which are quite unlike a vesica, and which may be a further development of the processes found in *pattoni*.

In Major Patton's colln., Coonoor, 7 ♂♂ 14 ♀, 15. iv. 20, 'in decomposing rabbit,' type, allotype and co-types.

Sarcophaga formosana, nom. nov.

(*Sarcophaga longicornis*, Bött. *nec* Macq.)

(Plate XVI, fig. 36.)

13 mm. ♂ : *Head* : frons one-third to two-fifths an eye width. Lateral verticals weak or absent. Facials weak. Antennae black, third joint five times second, and almost reaching the mouth border. Palpi black. Mouth bristles ' rising almost to the antennal roots. *Thorax* : acrostichals only present as prescutellars. Posterior dorso-centrals four, the two anterior weak. *Abdomen* : second segment bare. GS1 grey pollinose, without stronger hind marginals. GS2 black. *Legs* : mid femora with widely spaced comb, but the individual bristles strong. Mid tibiae bare. Hind femora fringed. Hind tibiae double fringed. *Wings*: vein I bare.

Unknown to me. The type and allotype from Formosa are still unique. The foregoing description is compiled from that of Böttcher, who himself (1913e) pointed out that his name was a *nomen bis lectum*, but did not indicate another for the species.

Sarcophaga orientalis Parker.

(Plate XVI, fig. 34.)

9 mm. ♂ : *Head* : frons equal to half an eye width. Lateral verticals present or absent. Frontals diverging. Facials weak except lowest. Genals weak and black anteriorly, white, soft and thick behind. Three rows post-ocular cilia, of which only one is at all definite. Frontal stripe black, the parafrontals together about as wide, these and face pale dull golden. Antennae black, third joint twice to two-and-a-half times the second. Palpi black. *Thorax* : yellowish grey. Acrostichals only prescutellar. Posterior dorso-centrals four, the two anterior weak. *Abdomen* : stripes brownish, complete, outwardly angled along the hind margin of second segment, which is bare. GS1 black, brownish pollinose, without marginals. GS2 black. *Legs* : mid femora with comb and basal fringe. Mid tibiae fringed on apical half. Hind femora fringed, lower hind macrochaetal row not noticeable therein. Hind tibiae double fringed. *Wings* : vein I bare. Costal bristle present. Segment iii of costa equal to v.

Described from one damaged specimen from the Philippines. Though there is considerable difference in the shape of the ' bulge ' on the basal anterior margin of the aedoeagus as figured by Parker and myself from different specimens I do not doubt that I have correctly recognized Parker's species.

One specimen is before me, in the Austrian State Museum, ♂, Bali, N.D., (Fruhstorfer).

Sarcophaga orientaloides, sp. nov.

(Plate XV, fig. 31.)

7-15 mm. ♂: *Head*: frontal width three-fifths that of an eye. Lateral verticals absent. Frontals diverging. Facials weak. Genals black, weak, posteriorly white. Three rows post-ocular cilia. Frontal stripe black, parafrontalia together rather wider. These and face golden. Antennae black, third joint twice second. Palpi black. *Thorax*: clear grey. Acrostichals only present as prescutellars. Five pairs posterior dorso-centrals. *Abdomen*: stripes usually complete, occasionally spot-like. Second segment without marginals. GS1 grey pollinose, no marginals. GS2 black. *Legs*: mid femora with comb and heavy fringe. Mid tibiae fringed. Hind femora strongly fringed, hiding the macrochaetal rows. Hind tibiae double fringed. *Wings*: vein I bare. Costal bristle small. Segment iii of costa longer than v.

Very closely allied in genital form to the preceding species. The two do not run out together in the external key, owing to variation in the number of posterior dorso-centrals, and though I have arranged the species in order according to external characters as a rule, in this case it is necessary to follow the genitalia. The peculiar form of the accessory forceps in both species is only found otherwise in *S. kempi*, nov., which possesses no other characters indicating close relationship. This would tend to show the need for much further work before the most reliable indication of relationship is decided upon.

The material before me is as follows:—

Imperial Dept. of Agriculture: Pusa; ♂, 23. ii. 07: ♂, ix. 07: ♂, N.D.: ♂, 10. iii. 13: ♂, 21. iii. 14: ♂, 31. ix. 15, 'bred in meat': ♂, 4. iii. 16, 'meat no. 1': 8♂, 8♀, 28. ii-7. iii. 16, 'meat plus borneol': 3♂, 2. iv. 19, 'meat' Chapra; ♂, N. D., (MacKenzie). Bombay; ♂, 27. iii. 05: Maymyo; ♂, 19-21. viii. 14, (Fletcher).

Imperial Forest Dept.: Dehra Dun; ♂, 21. v. 19, 'bred from lepidopterous larva': ♂, 21. xii. 21, (Bose).

Indian Museum: Sibsagar; ♂, N.D., (252): Tura; ♂, ix. 17, (Mrs. Kemp), 'larva feeding on waxy secretion of a Fulgorid.' Mergui; 2♂, $\frac{5523}{10}$, $\frac{5535}{10}$. Barkuda Id.; ♂, 17. ix. 19, (Brunetti).

Madras Dept. of Agriculture: Coimbatore: ♂, Manupatti, 29. v. 14: ♂, 11. xii. 20, 'bred in night soil.' Ottanatham, (Tinnevelly Dist.). 3♂, 12-22. iii. 15, 'bred in dead grasshoppers.'

Ceylon Agricultural Dept.: Peradeniya; 2♂, 2. iii. 21, (C.S. 4803), 'attracted to excrement in field': ♂, 2. viii. 22, 'bred in dead Sphingid larva': ♂, xi. 22, 'in *Aristolochia ridicula*.'

Austrian State Museum: S. India; ♂, N.D., (Fischer). Peradeniya; ♂, 22. xii. 01, (Uzel): Siam; ♂, Hinlap, January, (Fruhstorfer).

Colombo Museum: Colombo; 2♂, 19. v. 21.

Major Patton's colln.: Peradeniya; ♂, ii. 21. Kallar; ♂, vii. 20. Coonoor; ♂♀, 11. iv. 20, 'bred in meat.'

Author's colln. : Matale ; ♀, 17. vi. 18 : ♀, 14. iv. 19, allotype : ♂, 28. ix. 19, ' at *Poinsettia* ' : ♂, 26. viii. 20, type : ♀, 19. iv. 22 : ♂, 5. v. 22 : ♂, 28. vi. 22. Nalanda ; ♂, 17. i. 23, ' attracted to decaying *Achatina.*'

Sarcophaga pusana, sp. nov.

(Plate XIII, fig. 23.)

9 mm. ♂ : *Head* : frontal width one-third that of an eye. No lateral verticals. Frontals diverging. Facials strong. Genals white. Two rows post-ocular black cilia. Frontal stripe black, nearly linear, each parafrontal broader, these and face bright silvery. Antennae black, third joint two-and-a-half times second. Palpi black. *Thorax* : clear grey. Acrostichals only present as prescutellars. Posterior dorso-centrals four. *Abdomen* : second segment bare. GS2 red. *Legs* : no true comb on mid femora, but some longer bristles in its place ; fringe weak. Mid tibiae with trace of an apical fringe. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae double fringed. *Wings* : vein I bare. No costal bristle. Segment iii of costa equal to or rather longer than v.

Described from one imperfect specimen. The species must be extremely rare, as the type locality is one of the two in the whole Orient regarding which it can be said that the *Sarcophaga* fauna has been well collected, by breeding as well as the usual method. The type is in the Imperial Agricultural Dept. colln., one ♂, Pusa, 29. vii.13, (J.L.M.).

Sarcophaga crinita Parker.

(Plate XIII, fig. 24.)

7-9 mm. ♂ : *Head* : frontal width three-fifths that of an eye. No lateral verticals. Frontals diverging. Facials strong. Genals black. Three rows post-ocular black cilia. Frontal stripe very dark brownish black, parafrontalia together rather broader, these and face silvery white. Antennae black, third joint two-and-a-half times second. Palpi black. *Thorax* : dark slaty grey. Acrostichals only present as prescutellars. Four posterior dorso-centrals. *Abdomen* : second segment with marginals. GS2 black. *Legs* : mid femora with comb, but no true fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row, hardly any fringe. Hind tibiae bare. *Wings* : vein I bare. Costal bristle strong. Segment iii of costa equal to v.

Originally described from the Philippines, the material before me includes the following specimens :—

Imperial Dept. of Agriculture : Pusa ; ♂, 3. iii. 05. Chapra ; ♂, N.D, (Mackenzie). Kodaikanal ; ♂, ix. 21, (Fletcher).

Indian Museum : Calcutta ; ♂, 29. vii. 07, (J.C.) : Mandalay ; ♂, 12. iii. 08, (Annandale).

Madras Dept. of Agriculture : Kazanthum, (Tinnevelly Dist.) ; ♂, 1-11. xi. 13, (Ponniah).

Sarcophaga khasiensis, sp. nov.

(Plate XI, fig. 15.)

9-12 mm. ♂ : *Head* : frontal width three-fifths that of an eye. Lateral verticals absent. Frontals hardly outward directed. Facials weak. Genals black, bristly. Three rows post-ocular cilia. Frontal stripe black, parafrontalia together not as wide, these and face dirty yellowish white, the former with darker reflections. Antennae black, third joint thrice second, and reaching some way below eye margin. Palpi black. *Thorax* : dark slate grey. Acrostichals only present as prescutellars. Posterior dorso-centrals five, the anterior pairs weak. *Abdomen* : second segment without marginals. GS2 black. *Legs* : mid femora with comb and basal fringe. Mid tibiae bare. Hind tibiae without lower hind macrochaetal row, and with fringe. Hind tibiae double fringed. *Wings* : vein I bare. Costal bristle present. Segment iii of costa longer than v.

The construction of the aedoeagus is superficially similar to that of *S. falculata,* Pand., but whether there is any real relationship is doubtful. The material before me is :—

Indian Museum : Kashmir ; ♂, (Pease, 1915).
Author's colln. : Cherrapunji ; ♂, 18. x. 20, type.

Sarcophaga futilis, sp. nov., (Bigot *ms.*)

(Plate XIII, fig. 21.)

9-11 mm. ♂ : *Head* : frontal width half that of an eye. No lateral verticals. Frontals not diverging. Facials strong. Genals sparce, dirty white. One row post-ocular black cilia. Frontal stripe black, parafrontalia together not as wide, these and face pale yellowish. Antennae black, second joint reddish brown, third at times appearing brownish, four times as long as second but barely attaining level of lower eye margin. Palpi yellow. *Thorax* : ground colour yellowish grey. Acrostichals only present as prescutellars. Posterior dorso-centrals five. *Abdomen* : second segment with strong marginals. GS1 with marginals. GS2 black. *Legs* : mid femora with comb and weak fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row, and fringe in larger specimens. Hind tibiae with fringe on inside only. *Wings* : vein I bare. Costal bristle weak. Segment iii of costa equal to v.

♀ : Frontal width equal to an eye.

With the next species, this stands very isolated from all the other Oriental forms ; the material before includes the following specimens :—

Imperial Dept. of Agriculture : Pusa ; 2 ♂, 4. ix. 07 : ♂, 20. viii. 09, (Howlett) : ♂, 19. x. 10, 'in jungle.' Chapra ;3 ♂, N.D., (MacKenzie). Dumraon ; ♂, 14. ix. 08, (Chatterjee). Nagpur ; ♂, 14. viii. 22. Gauhati ; ♂, vi. 21, (Mrs. Fletcher). Minbu ; ♂, 7-8. viii. 14, (Fletcher).

Indian Museum : Calcutta ♂, 4. ix. 07. Tollygunge, Calcutta ; ♂, 17. vii. 07, (Annandale). Furulia ; ♂, 13. x. 09, (Jenkins). Siliguri ; ♂, 29. vi. 06. Allahabad ? ♂, 14-15. viii. 09, (Lord). Dehra Dun , ♂, $\frac{5292}{8}$, Bigot's *ms.* type Barkuda Id.; ♂ ♀, *in cop.*, 17. viii. 20, (Dover).

Colombo Museum : Kandy ; ♂ ♀, *in cop.*, 26. viii. 14, the palpi are almost black.

Author's colln. : Habarane ; ♂, 5. x. 19, type : ♀, 10. x. 19, allotype.

Sarcophaga martellata, sp. nov.

(Plate XIII, fig. 22.)

10-11 mm. ♂ : *Head* : frontal width two-thirds that of an eye. Weak lateral verticals present. Frontals diverging. Facials very weak. Genals white. One row post-ocular cilia. Antennae yellow-red, third joint more than twice second. Palpi yellow. Frontal stripe black, parafrontals together about as broad, these and face silvery with dark reflections. *Thorax* : yellowish grey. Acrostichals only present as prescutellars. Posterior dorso-centrals five. *Abdomen* : second segment bare or with very weak marginals. GS2 black. *Legs* : mid femora with fringe and very short comb. Mid tibiae bare. Hind femora with fringe and lower hind macrochaetal row. Hind tibiae fringed on inside only. *Wings* : vein I bare. Costal bristle strong. Segment iii of costa equal to or rather longer than v.

♀ : Frons as broad as an eye. Frontals less strongly diverging. The three anterior posterior dorso-centrals very weak. The tip of apparent segment iv of abdomen with no trace of red.

The material before me is :—

Imperial Dept. of Agriculture : Dumraon ; ♂, 14. ix. 08, (Chatterjee).

Indian Museum : Calcutta ; ♂, 25. iii. 07 : ♂, 25. vi. 07.

Madras Dept. of Agriculture : Coimbatore ; ♂, 3. vii. 12 : ♂, N. D. (D.P.C.) : ♂, 1917, (P.S.N.), 'carrion fly' : ♂, 12 xi. 17 : ♂, 14. xi. 18 : ♂, 17. vii. 14, 'feeding at Nim fruits' : ♂, 10. xii. 20 : ♂, 12. xii. 20, 'bred in night soil.' Calicut ; ♂, 20. v. 20.

Austrian State Museum : South India ; ♂, N.D., (Fischer).

Colombo Museum : Niroddumunai ; ♂ ♀ *in cop.*, 2. ii. 14, type and allotype.

Major Patton's colln. : Kallar ; ♂, vii. 20. Madras Harbour ; 7 ♂, 1 ♀, ii. 21.

Author's colln. : Matale ; ♀, 23. v. 21, 'on window.'

Sarcophaga kempi, sp. nov.

(Plate XV, fig. 29.)

6-12 mm. ♂ : *Head* : frontal width half that of an eye. Lateral verticals wanting. Frontals nearly straight. Facials strong. Genals black anteriorly, behind whitish. Three rows post-ocular cilia. Frontal stripe black, parafrontalia together about as wide, these and face whitish, the former with black reflections. Antennae black, third joint grey pollinose, very strongly contrasted with the black second joint and about two-and-a-half times as long. Palpi black. *Thorax* : dark grey. Acrostichals only present as prescutellars. Five posterior dorso-centrals. *Abdomen* : second segment with hind marginals. GS1 grey pollinose, no marginals. GS2 black. *Legs* : mid femora with comb and basal fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae double fringed. *Wings* : vein 1 bare. Costal bristle present. Segments iii and v of costa equal.

♀: Frons equal to three-fifths an eye width.

Viewed in other directions than profile, it is seen that the long apical curved rods of the aedoeagus are crossed, tongs-like, at half their length.

The material before me includes :—

Imperial Dept. of Agriculture: Pusa ; ♂, 11. iii. 15, (Md.S.), 'on *Justicia* hedge.'

Indian Museum: Calcutta ; ♂, 30. iv. 10, (Kemp). Moulmein ; ♂, 28. ii. 08, (Annandale).

Ceylon Agricultural Dept.: Peradeniya ; 5 ♂, 2 ♀, 2. viii. 22, 'bred in dead Sphingid larva' : 11 ♂, vi. 22, 'in *Aristolochia ridicula.*'

Austrian State Museum: 'India ;' ♂, N. D., (Winthem). China ; ♂, N.D., (Winthem) : ♂ ♀, *in cop.*, (Winthem), all four specimens determined by Brauer and von Bergenstamm as *trentepohlii*, Sch. Siam ; ♂, Hinlap, January, (Fruhstorfer).

Author's colln.: Matale ; ♂, 4. iv. 19, 'among grass,' type : 2 ♂, 30. vi. 22 : 3 ♂, 3 ♀ 7-9. viii. 22, 'bred in *Achatina*,' allotype and cotypes : 6 ♂, 5 ♀, 15-19. x. 22, 'bred in *Achatina*' : ♂, 12. i. 23.

I have much pleasure in dedicating this species to Dr. S.W.Kemp of the Zoological Survey of India, whose collections have added so much to our knowledge of Indian diptera.

Sarcophaga tsushimae, sp. nov.

(Plate XVI, fig. 33.)

9 mm. ♂: *Head*: frons barely equal to half an eye. No lateral verticals. Frontals diverging. Facials weak. Genals black and bristly. Three rows post-ocular cilia. Frontal stripe black, parafrontals together rather wider, these are dark greyish, the face below golden. Antennae black, third joint two-and-a-half times second. Palpi black. *Thorax*: ground colour uncertain, (stained). Acrostichals only present as prescutellars. Posterior dorso-centrals (?) five. *Abdomen*: second segment bare. Genital segments brown, the first without marginals. *Legs* : mid femora without true comb and with basal fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and fringe. Hind tibiae double fringed. *Wings*: vein I bare. Costal bristle strong. Segment iii of costa longer than v.

Appears to be related to the Palearctic species of the *nigriventris*-Group in regard to the build of the aedoeagus. The unique type is in the Austrian State Museum, ♂, Iki Id., Straits of Tsushima, September, (Fruhstorfer).

Sarcophaga dux Thomson.

(*S. tuberosa*, Pand., *S. luzonensis*, Park., *S. ceylonensis*, Park.)

(Plate XIV, fig. 25.)

7-12 mm. ♂: *Head*: frontal width two-thirds that of an eye. No lateral verticals. Frontals diverging. Facials weak. Genals weak, anteriorly black, posteriorly white, (variable). Three rows post-ocular cilia. Frontal stripe black, parafrontalia together rather wider, these and face silvery, just tinged pale golden. Antennae black, third joint twice second. Palpi black, very exceptionally yellow. *Thorax*: ashy

grey. Acrostichals only prescutellar. Posterior dorso-centrals five, the anterior three weak. *Abdomen* : second segment bare. GS1 grey-yellow pollinose, no marginals. GS2 red, rarely black. *Legs* : mid femora with comb and basal fringe. Mid tibia bare. Hind femora with lower hind macrochaetal row and weak fringe. Hind tibia with double fringe, the outer weak. *Wings* : vein I bare. Costal bristle present. Segment iii of costa longer than v.

♀ : Frontal width equal that of an eye.

I have adopted the name given by Parker, (1919) for this species, though there seems no certainty that the type has been examined. Parker's figure would indicate that true *dux* is more nearly of the form *harpax*, but a specimen kindly sent me by that author has the prongs of the lateral processes wide-spread and elongate, as in his figure of *ceylonensis*, and a distinct brownish tinge to the genital segments. In the main species I would therefore sink *luzonensis* and *ceylonensis*, as characters founded on colour of cheek vestiture and post-ocular ciliary rows seem to be quite illusory. I have seen the Coimbatore material alluded to by Parker in describing *ceylonensis*, and it contains specimens with genital segments red and black. The series bred in *Achatina* at Peradeniya is also before me, except the specimens sent to Dr. Parker, and I consider them to be nothing but *dux* as here accepted.

The material before me includes the following specimens :—

Imperial Dept. of Agriculture : Pusa ; ♂, 26. ii. 06 : ♂, 6. xi. 05 : ♂, 25. ii. 07 : 7 ♂, 5 ♀, 6. vii. 07, ' bred in rotten dal,' (C.S.556) : ♂, viii. 07 : ♂, 26. ix. 07 : ♂, 1. viii. 08, ' bred ': 2 ♂, 14-25. vi. 08, ' bred in oyster ': 11 ♂, 9 ♀, 8. viii. 09, ' bred in wound on cow,' (Howlett) : 2 ♂, 4 ♀, 29. viii. 09, ' bred in dead beetle ': ♂, 12. vii. 09, ' bred in dead snake ': ♂, 29. iv. 12, ' from shed ': 9 ♂, 13. ii. 13 :1 ♂, 3 ♀, 7-29. iv. 11, ' bred from dead snake ': ♂, 17. xii. 12 : ♂, 20. viii. 12 : 14 ♂, 14 ♀, 5. viii. 11, ' emerged ': ♂, 27. xi. 14, ' meat ': 3 ♂, 21. viii. 15, ' meat from square box ': ♂, 27 viii. 15 : ♂, 5. viii. 15, ' no. 1 meat ': 1 ♂, 2 ♀, 21. viii. 15, ' tin no. 2 ': ♂, 9. i. 15, ' attracted to rotten meat ': 16 ♂, 24 ♀, 19. i. 16, ' no. 2 tin, meat plus vanillin ': 22 ♂, 14 ♀, 19. i. 16, ' no. 3 tin, meat plus papain plus HCl,' 2 ♂ with GS2 black : 7 ♂, 17 ♀, 29. ii. 16, ' meat plus vanillin ', one ♂, GS2 black : 8 ♂, 7 ♀, 27 ii-2. iii. 16, ' meat plus borneol '; 2 ♂, 2. vii. 19 : 6 ♂, 8 ♀, i. 22, ' from meat ': 3 ♂, N.D.,: ♂, vii. 22, (Sen), ' bred in scalp wound of baby ': 6 ♂, 11-20. xii. 22, ' from Gastropod ': 5 ♂, 8 ♀, vii. 22., ' in decaying toad.' Howrah ; ♂, Domjur, 15. ii. 10, 'on a cow.' Bombay, ♂, Parel, 7. iii. 05. Puri ; ♂, N.D., (Vety. Asst.). Cuttack ; ♂, 15. vi. 08, (Maitra). Sambalpur ; 3 ♂, 1 ♀, 5. viii. 08. Jullundur ; ♂, iii. 09, ' no. 3 bullock,' (per C.V.D. Punjab) : Peshawar ; 1 ♂, 2 ♀, 7. v. 14, ' bred in cucumber.'

Imperial Forest Dept. Dehra Dun ; ♂, iii. 18, (Sinha), GS2 black.

Indian Museum : Calcutta ; ♂, 18. ii. 05, (Brunetti) : ♂, 20. ii 07 : ♂, 18. vii. 07, (Annandale) : ♂, 20. viii. 07 : ♂, 18. vi. 08, ' in Museum ', (Annandale) : 2 ♂, 9 ♀, vii. 20, ' bred in dead *Indoplanorbis exustus*,' (Sewell) : 4 ♂, 4 ♀, 8. v. 11, (Brunetti), ' larvae in decomposing crow's eggs.' Port Canning ; ♂, 6. xii. 07. Kashmir ; 4 ♂, (Pease 1915) : ♂, Jhelum Valley, vii-ix. 16, (Pease). Madras ; ♂, N.D., (Patton).

Madras Dept. of Agriculture : Coimbatore ; 2 ♂, 9. x. 13, ' bred from dead snake,' (Fletcher), GS2 black in one specimen : ♂, 16. iv. 14, ' *in cop.*, on *Calotropis* near excrement ': ♂, 4. iv. 14, GS2 black : 9 ♂, 7 ♀, 23-25. vii. 14, ' bred in dead squirrel.'

Ceylon Department of Agriculture : Peradeniya ; 11 ♂, 27. vii. 20, ' bred in dead *Achatina fulica*,' (C.S.4643) : 5 ♂, 2. iii. 21, ' attracted to excrement in field ', (C.S.4803).

Austrian State Museum : Calcutta ; 2 ♂, $\frac{1472}{6}$, (ex Indian Museum). Java ; ♂, N.D., (Fruhstorfer), GS2 black. Bali ; ♂, N.D., (Fruhstorfer), GS2 black. Tranquebar ; ♂, N.D., detd. by Brauer and von Bergenstamm as *hügellii*, Sch. " Ind. Or." ; ♂, (Hügel-37), determined by Brauer and von Bergenstamm as *hügellii*, Sch.

Cambridge University : Amara ; ♂, 28. iii. 18, (Buxton) : ♂, 14. iv. 18, (Buxton).

Colombo Museum : Colombo ; ♂, 18. xi. 14 : ♀, 21. iii. 14, palpi yellowish : ♂, 4. iv. 21, ' Kotte ': ♂ ♀, *in cop.*, 19. v. 21.

Author's colln. : Matale ; 2 ♂, 2 ♀, 3-4. vi. 18, ' bred in dead *Acherontia sp.*' : 3 ♂, 1 ♀, 2-3. iv. 22, ' bred in dead *Achatina* ': ♂ ♀, 19. iv. 22, ' *in cop.*': ♂, 28. vi. 22. Emelina, (Maskeliya Dist.) ; ♂, 25-29. xii. 18. Pusa ; ♂, 14. xi. 20. Hawaii ; ♂, 1-11. iv. 17, ' Oahu,' (Timberlake) : ♀, 20. x. 17, ' Honolulu '; (Timberlake). Madras ; ♂ ♀, Guindy, N.D., paratypes of *ceylonensis*, Park. For the last and the Hawaiian specimens I have to thank Dr. R. R. Parker.

Sarcophaga dux Thoms. var. **harpax** Pand.

(*Sarcophaga subtuberosa*, Park.)

(Plate XIV, fig. 25*a*.)

Differs from the type form by the facials strong, and the genals all black, though sparce. GS1 grey pollinose, GS2 black. The only really valid difference lies in the different shape of the tip of the lateral apophysis of the aedoeagus.

This form appears to be valid, whether it be accorded specific or sub-specific rank, though of the latter alone I consider it worthy. Parker's figure of 1917 clearly indicates this form.

The material before me includes the following specimens :—

Imperial Dept. of Agriculture : Pusa ; ♂, 14. xii. 16, ' on cow dung ': 7 ♂, 9-20. xii. 22., ' from Gastropod.' Dacca ; 5 ♂, xii. 11, (Sen), ' sweeping.' Chapra ; ♂, N.D., (Mackenzie, 479).

Indian Museum : Berhampur, (Murshidabad Dist.) ; ♂, 1. i. 08, (Lloyd), palpi yellow. Barkuda Id., ♂, 20. vii. 14, (Chilka Survey), ' at light.'

Ceylon Agricultural Dept. : Peradeniya ; 5 ♂, xi. 22, ' in *Aristolochia ridicula*.'

The species with its varieties, to which Parker now grants specific rank apiece, is almost universally distributed. Previously recorded in the Orient by Böttcher from Formosa, Singapore and Japan, Parker has recorded it under different names from Guam Id., Philippines, Mad-

ras Presidency and Ceylon. It is found in mid and southern Europe and in Damaraland, (Böttcher).

There remains the question of Parker's new sp., *S. craggi*. Parker's figure indicates, as he says, " specific differences in the anterior claspers," whilst the lateral apophysis of the aedoeagus is almost unbranched. In the examination of hundreds of specimens of the two forms recorded above I have seen nothing resembling this figure, though I have had material from the type locality. Either the species, (for of its specific rank there can be no doubt), is extremely rare, or else the Guindy label is wrongly applied, and the species is confined to Nyassaland.

Sarcophaga ruficornis Fabricius.

(Plate XIV, fig. 27.)

6-12 mm. ♂ : *Head* : frons equal to two-thirds that of an eye. Lateral verticals wanting. Frontals strongly diverging. Facials weak. Genals white. One row post-ocular cilia. Frontal stripe black, parafrontalia together as wide, the latter yellowish above, and silvery, as is the face, below. Antennae and palpi yellow-orange, the former occasionally darkened. Third joint of antennae twice second. *Thorax* : ashy grey. Acrostichals only present as one small prescutellar. Posterior dorso-centrals five, the front four very weak. *Abdomen* : the pattern of spots reduced, smaller than usual. Second segment bare. GS1 red, the posterior dorsal edge darkened, with none or only very weak marginals. GS2 red. *Legs* : mid femora with comb only, a few long basal hairs but no fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and weak fringe in larger specimens. Hind tibiae almost bare. *Wings* : vein I bare. No costal bristle. Segment iii of costa nearly twice as long as v.

♀ : Frontal width equal that of an eye. No acrostichal bristle and only one posterior dorso-central, (the hindmost). Tip of apparent fourth segment reddish.

Recorded by Böttcher from Formosa and Calcutta, and by Parker from the Philippines. Stated by Böttcher (1913 d) to be in Villeneuve's collection from North-East Africa and Socotra Id.

The material before me includes the following specimens :—

Imperial Dept. of Agriculture : Pusa ; ♂, 19. vii. 08, ' *in cop.*': 4 ♂, 1 ♀, 15. vii. 09, ' bred in dead snake ': 2 ♂, 2 ♀, 10. ix. 09, ' bred in dead snake ': ♂, vii. 07, antennae dark : ♂, 20. vii. 11 : ♂, 12. vi. 17 : ♂, 16. vi. 17, ' meat ': 2 ♂, 1 ♀, 2. iv. 19, ' in meat ': ♀, 13. v. 22 : ♀, iii. 19, (Dutt). Puri ; ♂, 'Birapani, Biswanathpur, on cattle,' 11. iv. 10 : ♂, 19. iv. 10, ' Bhobari Sahu, Banguari, on cattle.' Cuttack ; ♂, 14. viii. 08. Abbotabad ; ♀, 7 x. 22, (Fletcher). Coimbatore ; ♂, 9. xii. 13, ' bred in house ' Nagpur ; ♂, 27. iii. 04. Surat ; ♂, 26. xii. 04, ' on date palm.'

Imperial Forest Dept. : Dehra Dun ; 1 ♂, 2 ♀, 4. vii. 17, ' bred from dead rat.'

Indian Museum : Calcutta ; ♂, N.D., $\frac{761}{15}$, antennae dark : ♂, 8. vii. 14, (Gravely). Port Canning ; ♂, 21. vii. 07, (Annandale). Sylhet ; ♂, 19. xi. 04, (Hall). Waltair ; ♀, 20. iv. 10, (Kemp). Barkuda Id ;

♂, vii. 20, (Annandale). Dhauli, (Puri Dist.); ♂, 6. xi. 12, (Gravely). Purneah Dist., ♂, N.D., $\frac{884}{15}$. Ambala; ♂, 8-13. v. 05, (Brunetti). Dehra Dun; ♂, N.D., $\frac{5259}{8}$ determined by Bigot.

Madras Dept. of Agriculture: Coimbatore; ♂, 11. i. 13 : 9 ♂, 8 ♀, 25-28. vii. 14, 'bred in dead squirrel': ♂, 20. viii. 17, 'Botanic Garden': ♂, 20. ix. 20; ♂, 13. viii. 12, determined by Parker. Chikballiapur, (Mysore); ♂, 19. i. 15. Ottanatham, (Tinnevelly Dist.); 15 ♂, 7 ♀, 23-26. iii. 15, 'bred in dead grasshoppers' Virudupatti; ♀, 24-27. iii. 13, determined by Parker.

Punjab Dept. of Agriculture: Lyallpur; ♂, 7. xi. 22, (Nath). Gurdaspur; 9 ♂, 2 ♀, 6-9. xi. 22., 'bred in dead squirrel.'

Austrian State Museum: Plasun, (India); ♂, (1873). N. W. India; ♂, N.D., (Fischer). "Ind. Or."; 2 ♀, (Hügel, 38, 39), determined by Brauer and von Bergenstamm. Malacca; ♂, N.D.

Major Patton's colln.: Cuttack; 5 ♂, 1 ♀, 28. xi. 20, 'dumping ground.'

Author's colln.: Matale; ♀, 6. iv. 19 : ♀, 23. xii. 19 : ♀, 6. v. 21 : ♀, 25. ix. 22 : 8 ♂, 9 ♀, 14-16. x. 22, 'bred from ♀ of 25. ix. 22 on *Achatina*.' Madras; ♂, Guindy, N.D. [determined by Parker.]

Sarcophaga fuscicauda Böttcher.

(*Sarcophaga hutsoni* Park.)

(Plate XII, fig. 20.)

10-12 mm. ♂: *Head*: frontal width half that of an eye. No lateral verticals. Frontals straight. Facials weak. Genals short, black and bristly anteriorly behind, white, soft and long. Two distinct and one indistinct row of post-ocular cilia. Frontal stripe black, parafrontalia together about as broad, these and face silvery with dark reflections. Antennae black, third joint two-and-a-half times as long as second. Palpi black. *Thorax*: dark slaty blue-grey. Acrostichals only present as a prescutellar pair. Posterior dorso-centrals five, the first three weak. *Abdomen*: second segment with or without marginals. GS1 grey pollinose, no marginals. GS2 brown, occasionally blackish, sometimes reddish. *Legs*: mid femora with very wide spaced comb, and no true fringe. Mid tibiae bare. Hind femora with lower hind macrochaetal row and weak fringe. Hind tibiae with only traces of inner fringe apically. *Wings*: vein I bare. Costal bristle weak. Segment iii of costa longer than v.

♀: Frontal width three-fifths an eye.

A peculiarity in this species is the development of small spines on the superior claspers, best seen in three-quarter view from behind in occasional specimens. Such are indicated in the locality details, but the variation does not seem to me to be sufficiently fixed to warrant a distinctive name for such. A ♂ from Java and another from Borneo have the anterior claspers apically furcate, very much like the lateral apophysis of the aedoeagus of true *dux*.

The first posterior dorso-central is very weak and if overlooked, the species runs out with *albiceps* in the external key. From this the almost bare hind tibiae at once distinguish it.

I have no doubt in sinking Parker's *hutsoni* here. The separation is based on the brighter colour of GS2 and the differing number of rows of post-ocular cilia. I have seen the balance of the series (no. 4426, Peradeniya) from which the types were selected, and also one of the females labelled ' parasite on grasshoppers on cumbu.' Parker states " forceps essentially alike and penes quite similar."

Originally described from Formosa, Böttcher subsequently recorded it from Singapore. Parker has recorded it, (as *S. hutsoni*), from South India and Ceylon and has kindly forwarded to me a specimen from Oahu, (Hawaii, Timberlake), and another from Gordon Vale, North Queensland.

The material before me is as follows :—

Imperial Dept. of Agriculture : Pusa ; ♂, 6. vii. 15, ' meat.' Corloso ; ♂, 21. v. 17. Dacca ; ♂, xi. 11, ' cow.' Bombay ; ♂, 19. iii. 05, ' Vihar Lake ': ♂, 27. iii. 05.

Indian Museum : Mussoorie ; ♂, $\frac{2133}{16}$, (Brunetti). Ratnagiri District ; ♂, 28. x. 12, ' Akalpur to Valwar,' superior claspers spinulose. Rangoon ; ♂, 25. ii. 08, (Annandale). Mergui ; 2 ♂, N.D., $\frac{5546}{10}$: $\frac{5553}{10}$, superior claspers spinulose. Port Blair ; 6 ♂, 15. ii.-15. iii. 15, (Kemp). Sarawak ; ♂, 2. vii. 10, (Beebe), ' Sibu,' anterior claspers furcate Sadiya ; ♂, $\frac{5075}{5}$, determined by Bigot as ' *indica*, n. sp.', but never published.

Madras Dept. of Agriculture : Coimbatore : ♂, 2. x. 17 : ♂, 19. ix. 20 : 4 ♂, 7-10. ix. 20, ' bred in dead rabbit,' (Ballard) : 2 ♂, 7. ix. 20. Ottanathan ; ♀, 19. iii. 15, ' parasite on grasshopper on cumbu,' determined by Parker as *hutsoni*.

Ceylon Agricultural Dept. : Peradeniya ; 9 ♂, 1. viii. 19, ' in *Aristolochia ridicula* flowers,' (C.S. 4426) : 4 ♂, 4 ♀, 6. v. 22, ' bred in dead *Achatina*,' (C.S.6044) : 1 ♂, 1 ♀, 7. v. 20, ' bred from dead *Lepidiota pinguis*,' (C.S.4606), GS2 black ; determined by Parker as *fuscicauda*.

Austrian State Museum : India ; ♂, 1889 : ♂ , N.D., determined as *trentepohlii*, Sch. by Brauer and von Bergenstamm. S. India ; ♂, (Fischer, 1892), superior claspers spinulose. Java ; ♂, N.D., (Fruhstorfer), anterior claspers furcate. Tsushima Id., ix-x, (Fruhstorfer), GS2 black.

Major Patton's colln. : Kallar ; ♂, 22. ix. 20, ' on cow ': ♂, vii. 20. Coonoor ; 6 ♂, 11. iv. 20, ' bred in meat ': 1 ♂, 2 ♀, 7. iv. 20, ' in decomposing rabbit,' superior claspers spinulose : ♂, ♀, 2. vi. 20, ' bred,' superior claspers spinulose : 13 ♂, 14 ♀, 21-25. v. 20, ' in decomposing rabbit,' GS2 black in 3 and red in 7 of the males. Madras ; 2 ♂, 1 ♀, N.D., ' in external myiasis case.' 57 ♂, 77 ♀, N.D. or data. Mungpu, (Darjiling District) ; ♂, 14. x. 20, ' in kitchen, 3800 ft.'

Author's colln. : Matale ; 9 ♂, 13 ♀, 31. iii. 22, ' bred in dead *Achatina* ': ♂, 20. vi. 22, ' on window.' Nalanda ; ♂, 17. i. 23, ' at decaying *Achatina*.' Peradeniya ; ♂, 1. viii. 19, (C.S.4426), [paratype of *S hutsoni*, Park.]

Sarcophaga fletcheri, sp. nov.

(Plate XIV, fig. 26.)

7-9 mm. ♂: *Head*: frontal width two-fifths that of an eye. No lateral verticals. Frontals not diverging. Facials weak. Genals white and weak. One row post-ocular cilia, the other occipital hairs white, soft and long. Frontal stripe black, parafrontalia together as wide, these and face silvery. Antennae black, third joint twice second. Palpi black, sometimes yellow. *Thorax*: pale ashy grey. Acrostichals only present as prescutellars. Posterior dorso-centrals five, the three anterior very weak. *Abdomen*: second segment with strong marginals. GS2 black. *Legs*: mid femora with comb-like row of bristles, but hardly a true comb. Basal fringe very weak. Mid tibiae bare. Hind femora with lower hind macrochaetal row and weak fringe. Hind tibiae hardly fringed. *Wings*: vein I bare. Costal bristle present. Segment iii of costa longer than v.

The development of the giant macrochaete on the apex of the accessory forceps on the right hand side of the insect is not always so pronounced as in the specimen figured, it is sometimes no stronger than the one on the opposite side.

The material before me is :—

Imperial Dept. of Agriculture: Pusa; ♂, 11. vi. 07, 'on grass,' (S.R.), type.

Indian Museum: Calcutta City; ♂, 20. i. 07, (Brunetti). Balugaon, ♂, 14. xii. 08, (Caunter).

Madras Dept. of Agriculture: Coimbatore; ♂, 10. xii. 20, (A.A.), 'bred from night soil.'

I have much pleasure in dedicating this rare species to my friend and former Chief, the Imperial Entomologist.

Sarcophaga ballardi, sp. nov.

(Plate XI, fig. 16.)

11-12 mm. ♂: *Head*: frontal width two-thirds that of an eye. No lateral verticals. Frontals weakly diverging. Facials weak. Genals white. One row post-ocular cilia. Frontal stripe dark grey, its margins not well defined, parafrontalia together not as wide, these and face silvery, pale golden tinged. Antennae orange-yellow, third joint thrice second. Palpi concolorous. *Thorax*: ground colour whitish grey. Acrostichals quite absent. Posterior dorso-centrals six, the anterior four weak. *Abdomen*: second segment bare. GS2 red. *Legs*: mid femora with very strong comb and weak fringe. Mid tibiae bare. Hind femora without lower macrochaetal row and with fringe. Hind tibiae strongly double fringed. *Wings*: vein I bare. Costal bristle present. Segment iii of costa nearly twice segment v.

Described from two ♂ from Coimbatore, the type on 14. vi. 16 and the other specimen on 10. x. 19, both in the collection of the Madras Dept. of Agriculture.

I have much pleasure in dedicating this beautiful and contention-raising species to the Government Entomologist, Madras, whose breeding experiments have added considerably to our knowledge of the bionomics of the genus.

Sarcophaga haemorrhoidalis Meigen.

(Plate XV, fig. 30.)

10-14 mm. ♂: *Head*: frontal width equal to an eye. Lateral verticals present but weak. Frontals diverging. Facials weak. Genals white. Two rows post-ocular cilia. Frontal stripe black, parafrontalia together not as wide, these and face fuscous white. Antennae black, third joint thrice second. Palpi black. *Thorax*: yellowish-grey. Acrostichals quite absent. Posterior dorso-centrals six, the anterior four very weak. *Abdomen*: second segment without marginals. GS1 grey pollinose, with strong marginals. GS2 red. *Legs*: mid femora with comb but hardly any basal fringe. Mid tibiae with traces of an apical beard. Hind femora with lower hind macrochaetal row very strong, but no separate fringe. Hind tibiae double fringed. *Wings.* vein I bare. No costal bristle. Segments iii and v of costa equal.

Recorded by Böttcher from all Europe, Africa and North America, and from 'Turkomania,' (? Turkestan), in Palearctic Asia, as well as from Darjiling and the Nicobars in the Oriental Region. I cannot but believe that the latter record is an error, based on faulty labelling. The species, as the undermentioned localities show, occurs throughout the Himalayan chain, but is absent from quite numerous collections made in Burma and the Andamans. Its sudden re-appearance, therefore, in the Nicobars is very unlikely. As far as I know no dipterous collections have been made in those islands since the visit of the Austrian frigate 'Novara' in 1858, and the specimen seen by Böttcher probably dated from that time. Its location in Europe is not stated. Of the accuracy of the specific determination there can be no doubt, but probably in the process of labelling up the extensive collections brought home from the voyage a mistake occurred. When further Nicobar collections are made I feel sure *haemorrhoidalis* will not be found amongst them, the old specimens so labelled having been obtained at some other port of call during the Novara's circumnavigatory voyage.

The material before me contains the following specimens :—

Imperial Dept. of Agriculture: Kurseong ; ♂, 18-30. iv. 22, (Fletcher). Darjiling ; ♂, viii, 08, (Middleton). Muktesar ; 10 ♂, 8 ♀, ix. 22, (Fletcher). Simla ; 2 ♂, 1 ♀, x. 08, (Howlett) : ♂, 4-7. vi. 21, (Fletcher).

Imperial Forest Dept. : Almora ; ♂, 26. iv. 19, 'Suini.'

Indian Museum : Siliguri ; 2 ♂, 18-20. vii. 07. Kurseong ; ♂, 13-16. vii. 07. Darjiling ; 2 ♂, 2-4. vi. 17, (Brunetti). Naini Tal ; ♂, (Lloyd, 1908) : 2 ♂, 2-8. viii. 20, (Prashad and Hora). Almora ; ♂, xii. 11, (Paiva). Mussoorie ; 3 ♂, N.D., (Brunetti) : 2 ♂, $\frac{994}{14}$, $\frac{1014}{10}$; 2 ♂, 28. v-2. vi. 05, (Brunetti). Simla ; ♂, 5. v. 07 : 3 ♂, 12-13. v. 13, (Annandale). Kulu ; ♂, N.D., determined as *taenionota*, Wd. Nasratabad, Seistan ; 3 ♂, 1 ♀, xi.-xii. 18, (Annandale and Kemp), 'in Consulate Garden,' [determined by Brunetti.]

Cambridge University: Baghdad; ♂, 10. ix. 17, (Buxton): ♂, iii. 20, (Rao). Karodeh; ♂, xii. 19, (Rao).

Author's colln.: Mungpu, (Darjiling Dist.); ♂, 6. i. 20: 2 ♂, 9-15. iv. 20, 2 ♂, 1 ♀, 12. i. 20, 'Rungbee': 1 ♀, 19. 1. 20, 'Rungbee Jhora': (all Shaw.)

If the foregoing table of external characters and the descriptions just given are compared with the table of the Palearctic species given in Appendix I, an interesting point is brought out, that whereas in the Palearctic fauna the genus has 70·4% of its species with three posterior dorso-centrals, in the Oriental fauna only 21·4% are so furnished, and of these, one third are really Palearctic forms only entering the region near its limits. If these be omitted the percentage falls to 14·3. Conditions of life in the Oriental Region have evidently conduced to a greater development of dorso-central bristles.

Though a more luxurious development of all characters and a greater extent of departure from the genotype facies may be said to characterize the Oriental species of genera common to both regions, not only throughout the Diptera but all through the animal and vegetable kingdoms, probably as the result of inhabiting a warmer area providing easier conditions of existence, it is noteworthy that whereas the Palearctic species of the genus include seven with large departures from the typical form, in venation, adornment or coloration, which render them conspicuous and distinguishable at a glance, in the Oriental, instead of the larger proportion that would be expected, there are only two such species, the resulting percentages being 8 and 5 respectively. Though of course the numerical muster of the genus is at present almost exactly double in the Palearctic as compared with the Oriental, this being the result of inadequate collecting in the latter region, still it is almost certain that the numerous species which probably await discovery will be distinguishable on genitalia characters only, and will not show any such noteworthy external characters; all such must have caught the eye of the general collector long since. The discrepancy in the proportion of noteworthy forms is probably real and not only apparent.

Comparing this state of affairs with another Cosmopolitan genus, *Tabanus*, the opposite is found. In the Palearctic Region the species are all very uniform in facies and extremely difficult of discrimination. In the Oriental Region, on the contrary, nearly 11% possess characteristic wing colour patterns that at once distinguish them from the ruck of the genus. Why two of the most dominant dipterous genera in the world to-day should exhibit such different lines of evolution in the same region is incomprehensible. Leading questions in biology of this nature must be many years before attempted of solution.

iv. The genus *Sarcophila*.

Sarcophila Rondani.

(*Leucomyia*, Brauer and von Bergenstamm.)

Apparently a genus of variable characteristics. As the single Oriental species had a special genus created for its reception by the Austrian

collaborators, it seems best to leave the composite genus undefined here, and to merely note the characters found in our species. The key on page 221 is drawn up having regard to this species only.

Sarcophila cinerea Fabricius.

(*Sarcophila alba*, Schiner.)

(Plate XVII, figs. 2, 4.)

5-7 mm. ♂.♀. : *Head*: frons very broad, equal to one-and-a-half times an eye in both sexes, produced anteriorly, so that viewed from the side the distance from the front edge of the rather small eye to root of antenna is equal to half an eye breadth in this view. Lateral verticals present in both sexes. Ocellars very strong, proclinate. Frontals parallel, wide spaced, not more than six in the row. Exterior frontals nil in ♂, three in ♀, the upper reclinate, the two lower proclinate. Facials absent, vibrissal ridges bare, genae only with soft white hairs. Only one row post-ocular black cilia, occiput otherwise almost bare, greyish. No frontal stripe, but a series of vertical black striae on lower half of frons within the interior frontals. Frons and face silvery white. Antennae grey pollinose, tip of second joint brownish yellow, third joint about twice as long as second. Arista brown, first joint incrassate, second microscopically pubescent on basal half, which is more yellowish. Palpi yellow, not apically clavate. *Thorax*: silvery ashy grey with indefinite darker stripes. Acrostichals nil, or only a very weak prescutellar pair. Dorso-centrals 2 : 3. Scutellum concolorous with mesonotum, (Schiner states that it is yellow round the margin, but this is very indistinct), with two marginals and a weak preapical pair of bristles, no apicals in either sex. Exceptionally, a weak middle sternopleural is developed. *Abdomen*: rather more cinereous grey. Apparent first segment with indefinite median dark stripe, second and third with oblique dark stripes, posteriorly diverging, leaving a pale median area on second, but fused together on third. Apparent fourth with straight dark median stripe. Genital segments both grey pollinose, without stronger hind marginals on first. *Legs*: dark blackish grey, in the ♂ without the adornments of *Sarcophaga*. *Wings*: clear, veins pale yellow. Costal bristle strong. Vein I bare, vein III with four or five bristles above and two or three below. Segment iii of costa much shorter than v.

Described from 'East India,' Schiner's synonym is from Ceylon. The material before me includes :—

Indian Museum: Puri; 10 ♂, 6 ♀, 18-19. i. 08, (Annandale); 'on sea shore': ♂, 20-21. i. 08 : 88 ♂, 5 ♀, 27-29. ii. 08, (Paiva). Varkalay, (Travancore Coast); 1 ♂, 2 ♀, 10. xi. 08, (Annandale).

Austrian State Museum: Ceylon; 2 ♂, 1 ♀, N.D., (Novara Reise), type and co-types of *alba*, Sch., the ♂ co-type is headless: 7 ♂, 1 ♀, N.D., (Fischer). Colombo; 3 ♂, 15. ii. 02, (Uzel). Agra; ♂ ♀, N.D., (Fischer).

Author's colln.: Trincomali; 3 ♂, 3 ♀, 6. x. 19, 'swarming among *Ipomaea* on beach.'

This is doubtless the species referred to by Fletcher (1907) as being preyed upon by *Cicindela biramosa* on the beech at Barberyn Island,

(Ceylon, S.W. coast). The Agra locality in the Vienna Museum is obviously wrong. The species is confined to the sea shore entirely. Nothing seems known of its habits, but in all the collections but my own above detailed, the males far exceed the females in numbers.

v. THE GENUS *Agria*.

Agria Macquart.

Another genus of varying characteristics, which was defined by Brauer and von Bergenstamm (1893) without considering the only species which penetrates our region. It therefore seems best to no more define the genus than will serve to locate our two species. For this the key on page 221 serves. The two Oriental species separate as follows :—

Legs black	..	*nuba* Wied.
Legs yellow		*hutsoni*, nov.

Agria nuba Wiedemann.

Unknown to me, Wiedemann's description is as follows :—

" Of slimmer build than *T brevicornis*. Antennal roots brown-red, the end segment twice as long as the second, blackish, strongly grey pollinose. Palpi reddish yellow. Face brownish, but with strong yellowish white shimmer. Frons grey-yellow, above with the narrowly developed eye-margins clear yellowish silvery shining. *Thorax* : dorsum yellowish. I cannot state the pattern, as in my specimen the median area has become oily and black. Pleurae blackish, with grey-white pollen. *Abdomen* : on each segment with three deep black spots, placed at the apical margins of the segment, the median spot of the second segment lengthened stripe-like to the first segment, which also has its own three spots. The spots do not change with the point of view. *Wings* : uncoloured, veins brown, cross-vein high above the apex. Squamae white. *Legs* : black, the femora grey dusted. 4 lines. From Nubia. In the Berlin Museum and my own collection."

Since recorded from Karachi, (Howlett, 1909).

Agria hutsoni, sp. nov.

5 mm. ♀ : *Head* : lateral verticals and ocellars strong, the latter procumbent. Frons equal to three-fifths an eye width, its margins absolutely parallel from vertex to base of antennae. Exterior frontals three, the uppermost, which is on a level with the lowest ocellus, placed more inwards than the two lower pairs. Interior frontals widely separated, only seven in number, of which the three lowest are close together below the level of the antennal roots and outwardly directed. Frontal stripe dark brown, slightly tinged orange below, ending above the ocellar triangle, but separating the latter from the yellow cinereous parafrontalia with which it is concolorous by a pair of narrow diverging brown lines continued from its upper angles. The two parafrontals together rather wider than the frontal stripe. Face more silvery, cinereous, without carina, the facials strong and long, parallel to eye-margins. Vibrissal ridges bear only two short bristles above the vibrissae, which are crossed apically, and are situate the antero-posterior breadth of the third

antennal joint above the epistomal margin. Peristomal bristles strong, about ten, reaching the back of head. Genae grey, cinereous, black bristled, their height from lowest eye margin to peristome laterally equal to length of third antennal joint. Antennae brownish, thickly grey pollinose, second joint chaetose above, third joint barely twice as long as second. Arista with first joint slightly thickened, and as long as second antennal, bearing above six to seven rays and below one or two, the latter towards its tip. The rays are each wider than the third antennal joint antero-posteriorly. Second joint of arista with about three equal rays above and one or two below, all situate at its extreme base contiguous with the rays of the first joint, the remainder bare. Palpi pale yellow with black chaetae, slightly clavate apically. Occiput grey, with two rows of post-ocular black cilia. Proboscis black. *Thorax* : apparently brown, thickly covered throughout with yellowish ashy pollen. Chaetotaxy : scapulars strong ; acrostichals 4 : 5, all but the two last pairs very closely approximated, somewhat irregularly placed ; dorso-centrals 2 : 3, a much weaker fourth posterior just behind the suture; humerals 3 ; post-humerals 2 ; presuturals 1 ; alars 2 : 2 : 1 ; propleural 2, long, upcurved ; notopleurals 2 ; mesopleuron with fan of 5 along posterior margin, and some weaker, shorter, bristly hairs in anterior upper angle and along upper margin ; sterno-pleurals 1 : 1, both long ; hypo-pleuron with about 7 in straight row ; scutellars, 2 marginal, a sub-apical on disc at about two-thirds its length, and no apical. *Abdomen* : grey with ashy pollen. Apparent first segment with base black, two black spots laterally posteriorly ; apparent second segment with median black stripe, not reaching the hind margin, and lateral posterior black patches ; apparent third similar but median stripe evanescent, reduced to a few dark spots ; apparent fourth unicolorous grey. The black stripes and spots are fixed in position, not changing with light incidence, but their margins are not sharp, the colour fading there to brown. The median and lateral marginals arise from small round black spots. Chaetotaxy : each of first three segments with lateral discals and marginals ; apparent second with pair of strong median marginals ; apparent third with strong median and two pairs sub-median marginals ; apparent fourth with four strong bristles, two just above, and two just below, the upper angle of the genital cleft. The sternites appear to be outstandingly bristled, especially an apical pair of chaetae on apparent first. *Legs* : coxae grey pollinose, concolorous with thorax, remainder yellow. Front coxae with long macrochaetal front row ; front femora with long bristles above and below ; mid femora with one long bristle below premedianly ; mid tibia with an anterior, posterior and inferior sub-mesal bristle ; hind femora with upper anterior row, and a median and two sub-apical inferior. Hind tibia with five upper anterior bristles, lengthening to hindmost, and two upper posterior at one-third and two-thirds length respectively. *Wings* : clear, veins yellow. No costal bristle. Segment iii of costa a little less than segment v. Vein I bare, vein III bristly above half way to anterior cross vein, below on node only. Anterior cross vein oblique posteriorly ; just beyond middle of discal cell and below tip of vein I. Vein IV bent at right angles, but thereafter gradually sloping outwards. First posterior cell closed in

margin well before apex. Posterior cross vein bent outwardly anteriorly at half length, its posterior half parallel to basal half of last section of vein IV, the cross vein nearer to bend of IV than to anterior cross vein. Squamae pale yellowish white.

Described from a unique female in good condition taken among grass, Suduganga, Matale, Ceylon, on 9. xi. 19. The type is the only specimen known to me and though I have repeatedly searched for more, I have never succeeded in again taking it. It is not represented in any of the collections sent me, and is evidently a very rare species. I have much pleasure in dedicating it to Dr. J. C. Hutson, Government Entomologist, Ceylon.

vi. The genus *Wohlfartia*.

Wohlfartia Brauer and von Bergenstamm.

Though not recorded from the Oriental Region I have included this genus in the table on page 221, as there is little doubt in my mind that it will ultimately be found in Baluchistan and the Trans-Indus country. Sinton (1921) records a case of myiasis in a camel in North-East Persia by the larvae of an undetermined species of this genus. I have in my own collection a female from Shebin-el-Kôm, Egypt, 31. vii. 17, ' bred in human eye,' kindly sent me by Dr. Lewis Gough, belonging to *Wohlfartia magnifica*, Sch.

The following species are recorded from the arid regions to the North and West of India :—

W. tertripunctata L-Duf.	Central Asia.	(Sinton, 1921).
W. magnifica, Sch.	S. Russia. Egypt. N. Africa.	(Sinton, 1921).
W. meigenii, Sch.	Mesopotamia.	(Patton, 1920).
W. balaglossi, Port.	Central Asia.	(Sinton, 1921).

The characters used in drawing up the table on p. 221 are taken from my specimen of *magnifica*, which is the only species actually known to me.

IX. ZOO-GEOGRAPHICAL.

' Bestimmungs tabellen sind nicht das höchste zoologische ideal '— Böttcher.

The distributional data furnished by the foregoing records of localities afford considerable information. Undoubtedly, on account of its ubiquity, the genus *Sarcophaga* at least has been one of the best collected in the Orient. I feel certain that in few other genera of diptera would over 2,500 specimens be forthcoming as material to an author undertaking its revision.

In table II the distribution of the forty-two species and varieties of *Sarcophaga* are tabulated in twenty-nine areas of distribution. In respect of these areas, their limits are mainly explained by the headings of the columns, but the inclusion of certain localities demands explanation.

Dehra Dun is treated as ' Indo-Gangetic Plain, West ' in preference to recording species from thence as ' West Himalayan.' As *S. haemorrhoidalis* is absent and *S. dux*, for instance, occurs there the probabili-

ties are that the faunal affinities, in this sub-family at least, are with the plains rather than with the hills. *Coimbatore* and *Kallar* are treated as 'South Malabar,' the dividing line at this point between S. Malabar and the Carnatic being regarded as passing east of Podanur. Strictly, of course, the district, being on the eastern side of the main range of the Ghats, is Carnatic, but it is situate too much in among the hills to make it safe to deduce that species found there are otherwise Carnatic. This decision was arrived at after drawing up table II twice, in one draft Coimbatore species being included in area 12, and in the other in area 19, when it was decided that the affinities of the species seemed better satisfied by the former allocation, and the district is regarded therefore as an outlier of South Malabar.

In regard to the Northern boundary of the Carnatic with the Indo-Gangetic Plain, East, this is taken at the Mahanaddi. *Puri* and *Cuttack* species are attributed to the Indo-Gangetic plain, *Chilka Lake* species to the Carnatic. The boundary of the Indo-Gangetic plain and the Delta region of Assam is taken at the Meghna, and *Dacca* species are therefore attributed to the latter.

Mahableshwar is regarded as 'North Malabar;' *Medha* as 'Central India,' and *Dharwar* as 'Carnatic,' taking the Kistna as the boundary at this point. *Kathiawar* is included in 'Rajputana.'

The map (plate XIX) shows the position of nearly all places mentioned in the localities given under each species in part VIII, the exceptions being a few which I have been unable to trace on any map.

Taking now each species separately :—

S. calcifera, Bött. seems to be a Malayan species, its Indian localities all being in areas with general Malayan affinities.

S. josephi, Bött. is confined to Formosa. The relationship shown by the aedoeagus with the *melanura* and *carnaria* Groups would indicate that it is a Palearctic species reaching Formosa with the former of these. Practically nothing seems to be on record with regard to North China and Japan forms, the few specimens from the latter that I have seen being all from the southern extremity of the country. Böttcher is silent in regard to Japanese distribution of Palearctic species.

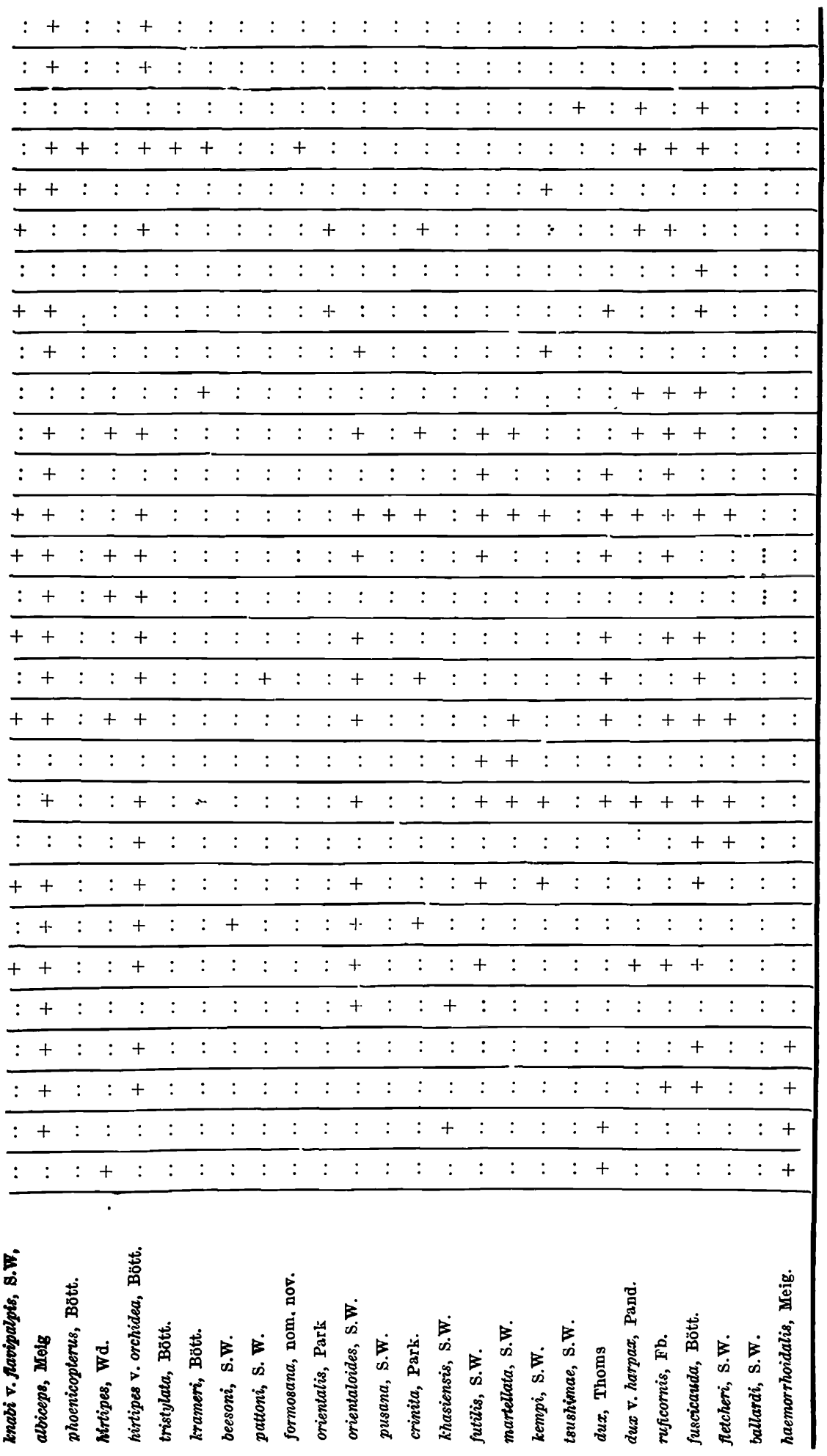
S. caudagalli, Bött. equally appears to be a Malayan species.

S. melanura, Meig. is a Palearctic species, only passing into the Oriental in Kashmir and China, in the intervening longitudes evidently passing to the north of the Himalaya through Tibet.

S. falculata, Pand. is purely Palearctic. The variety *persicae,* nov. is known to me from Ambala in the plains at the foot of the Western Himalaya. The Mussoorie specimen seen by Böttcher may belong to either form, if to the type, then the Mesopotamia-Ambala variety is a southern form, and the type-form must run through Central Asia to the Himalaya, whilst if it ultimately proves to be of my variety then the type-form is not seen east of Egypt. Unless the types have been compared I am sceptical of Parker's synonomy with the Hawaian *barbata,* Thoms.; *falculata* is not recorded from the Nearctic Region, nor does it seem to reach the shores of the Pacific on the Old World side. If type examination has proved identity, then the case is one of most remarkable discontinuous distribution.

TABLE II.—*Zonal distribution of the Oriental species of Sarcophaga.*

Species.		
calcifera, Bött.	:	*E. Palearctic.* Mesopotamia-Persia.
josephi, Bött.	:	*Pamirs.* Turkestan-Kashmir.
caudagalli, Bött.	:	*W. Himalaya.* Kulu-Sarda R.
melanura, Meig.	:	*E. Himalaya.* Nepal-Teesta R.
falculata v. *persicae*, S. W.	:	*Assam Hills.* Garos-Manipur Hills.
flavinervis, S.W.	+	*Assam Plains.* Brahmaputra Valley. Surma Valley.
gravelyi, S.W.	:	*Upper Burma.* North of Mandalay.
uspinata, S.W.	:	*Lower Burma.* Minbu-Mergui.
haematodes, Meig.	+	*Bay Islands.* Andamans, Nicobars.
walayari, S.W.	+	*Ceylon, Southern.* Dondra Head-Nalanda.
aurifrons, Dol.	+	*Ceylon, Northern.* Dambulla-Pt. Pedro.
henryi, SW.	+	*S. Malabar.* C. Comorin-Mangalore.
anilispe, Bött.	+	*S. Indian Hills.* Palneys, Bahabuddins.
ostindicae, S.W.	:	*N. Malabar.* Goa-Surat.
annandalei, S.W.	+	*Rajputana.* Ahmedabad-Delhi.
knabi, Park.	+	*I-G. Plains, West.* Peshawar-Jumna R.
	+	*I-G. Plains, East.* Jumna R.-Calcutta.
	:	*Central India.* Poona-Sambalpur.
	+	*Carnatic.* Chilka lake-C. Comorin.
	+	*Malaya.* Victoria Point-Singapore.
	:	*Indo-China.* Siam. Tonkin.
	+	*Java.* W. and E. Bali.
	:	*Borneo.*
	+	*Phillppines.*
	:	*China.* Including Hong Kong.
	:	*Formosa.*
	:	*Japan.*
	:	*Celebes Area.* Lombok. Moluccas.
	:	*New Guinea.*


knabi v. flavipalpis, S.W.
albiceps, Meig
phoenicopterus, Bött.
hirtipes, Wd.
hirtipes v. orchidea, Bött.
tristylata, Bött.
krameri, Bött.
beesoni, S.W.
pattoni, S. W.
formosana, nom. nov.
orientalis, Park
orientaloides, S.W.
pusana, S.W.
crinita, Park.
khasiensis, S.W.
futilis, S.W.
martellata, S.W.
kempi, S.W.
tsushimae, S.W.
dux, Thoms
dux v. harpax, Pand.
ruficornis, Fb.
fusciauda, Bött.
fletcheri, S.W.
ballardi, S.W.
haemorrhoidalis, Meig.

S. flavinervis, nov. A purely Malayan species just entering the head of the Assam Valley.

S. gravelyi, nov. Being recorded from a single locality only it is impossible to decide anything regarding the affinities of this very isolated species.

S. aspinata, nov. This species has been bred at Coimbatore on three separate occasions, but much breeding elsewhere, at Coonoor, Pusa and Matale, has failed to discover it. As noted under the actual description it is a peculiarly interesting species, and if really confined to a small area among the Ghat foothills, thefact is extremely suggestive. May it not represent the remains of a link in evolution elsewhere exterminated ?

S. haematodes, Meig. A purely Palearctic species running along the Himalaya from the Karakoram Pass to the Teesta, and not otherwise entering the region.

S. walayari, nov. I have a strong suspicion, though as yet the evidence is too slight to permit the putting forward of a definite hypothesis, that one of the principal factors in *Sarcophaga* distribution is light incidence, and that when forest areas are systematically searched for the species of this genus, these, as in *Culicidae*, will be found to differ from the species of the open formations. This form probably belongs to such heliophobic species.

S. aurifrons, Dol. Purely Malayan, and found in both the Indo- and Austro-Malayan sub-regions. I am unable to locate the " Manson Mountains " in Tonkin, but as far as the maps indicate, the mountainous regions in that province all appear to be in the north towards the Yunnan frontier. In this case it is possible that the species will ultimately be found within Indian limits in the South Shan States, but so conspicuous a species would certainly have been heretofore recorded if it approached the line of the Irrawaddy.

S. henryi, nov. As stated under the description, this species must await the discovery of specimens from a less cosmospolitan spot than Colombo for its inclusion in the Oriental fauna as aught but a possibly recent introduction.

S. antilope, Bött. Certainly a purely Malayan form, though related to the Palearctic *carnaria*-Group. Its occurrence in Ceylon is probably purely fortuitous. I had already become acquainted with the species in the course of this work when my Matale specimen was taken. At that time I was in correspondence with Mr. A. J. Bamford of the Colombo Observatory in regard to the hypothesis of insect transmission by Upper Currents put forward with instances in the remarks in the discussion following the reading of Major Christopher's paper on the distribution of Indian mosquitos, (Christophers, 1921). Accordingly, I immediately informed Mr. Bamford of this new case, and the latter, after studying the Indian Daily Synoptic Weather Chart for the date wrote me, " It shows very strong N. E. winds in the centre of the Bay, the beginning of what developed into quite a nasty cyclone." *Sarcophagae*, in my experience, are always rare at light, and the occurrence in my own bungalow of a specimen proving to belong to such a rare form under these and no other circumstances is more than unlikely if its being hitherto

overlooked were the result of mere chance only. The occurrence is strictly parallel to the capture of a single specimen of *Acanthina azurea*, Gers., as recorded in Christophers, 1921.

S. ostindicae, nov. Being without exact locality, nothing can be said regarding this species.

S. annandalei, nov. A great rarity, though obtainable in some numbers by suitable breeding. Outside my own window captures it seems to have been only once netted, all other records giving it as bred. This being so, it is probably more widely distributed than the records indicate. At present it separates into two groups, a Gangetic Plains one, (though the two localities are far apart and one is strictly plains, the other sub-montane), and a Ceylon-S. Indian hills group, and further records are required to join these up.

S. knabi, Park. Is a common species, the centre of distribution of which would seem to lie in Indo-Malaya, from which it extends along the Indo-Gangetic Plain as far as Ambala, and *via* the Andamans into Ceylon and the Malabar Coast. Its occurrence at Ahmedabad would indicate that this station has some North Malabar affinities, whilst it manages to push into two extremities of the Carnatic at Beeravalli and Barkuda Island, its course in reaching these being obvious. Eastwards it extends through the Malay Peninsula to Java and Bali, and it reaches the Philippines and China. The form *flavipalpis*, nov. is generally of more northerly location than is the type form, though exceptions occur. Breeding alone will settle the fate of my variety. The genitalia appear identical in every respect, but as the aedoeagus is not very strongly chitinized it is not possible to be as dogmatic on this point as is possible with some other species.

S. albiceps, Meig. As wide spread in the Oriental as in the Palearctic, it is apparently only absent from Mesopotamia, the Bay islands and North Ceylon, and from Malaya, the Philippines and Japan further East. Probably it will ultimately be found everywhere, but its continued absence from the fairly well collected Philippines is suprising, none the less. It passes beyond our limits into the Austro-Malayan Sub-region, but is not recorded from Australia proper.

S. phoenicopterus, Bött. Apparently confined to Formosa only. Böttcher's remark, (1913e), that the superior claspers of this species seem to relate it to certain South American forms, but to no Palearctic or Oriental ones, would render the examination of collections from the Pacific islands of peculiar interest.

S. hirtipes, Wd. The type form in our Region is confined to an area reaching from Ludhiana to Coimbatore, the southernwards extension passing along the eastern side of the Western Ghats, whilst the Malayan form *orchidea* Bött. runs along their summits and the Malabar Coast. Both forms are found together at Ahmedabad and Delhi.

Assuming that true *hirtipes* is a Southern Palearctic form that has spread into the Ethiopian and Oriental Regions, in the latter developing a sub-species so distinct that it has almost, (if not quite), attained specific rank, let us consider the lines of distribution probably followed. True *hirtipes*, as will as its extreme form *rufipes* Wd, considered by Böttcher (1913e) as unworthy of even varietal rank, was described from

Egypt. Böttcher records it from North Africa and Asia Minor, (1912c). On reference to Dr. J. J. Simpson's report on the Gold Coast, (Simpson 1914), I find that Larabanga, whence the specimen given me by Dr. Parker came, is in the dry savannah belt of the Northern Territories of that Colony. The rainfall is not stated, but at the nearest station, Tamale, it is about 46″ a year, and the climate there appears to be a typical South-West Monsoon one, with a long dry season from October to March. Similar conditions are found on the eastern side of the Western Ghats and through Rajputana to the Western Punjab, *i.e.*, in true *hirtipes* localities in our Region. I would therefore put forward the following tentative hypothesis to account for the facts recorded.

The centre from which the species spread was in North Africa. Westerly the species crossed the Sahara and Sudan and now reaches the dry portions of the Northern Territories of the Gold Coast which, according to Simpson, (*op. cit.*), is the driest portion of the British West African possessions. Eastwards it extended into Asia Minor, an area of low rainfall not exceeding 25,″ and across the Syrian desert through Mesopotamia, (where it is well represented in the few specimens sent me by Prof. Nuttall), into Baluchistan and the Indus Delta, passing thence into the Indian desert, whence the extremely pale *rufipes* form indicative of such conditions is recorded from Deesa, but unfortunately on a specimen not determined by genitalia examination. Nevertheless, this form being one of exceptional colouring, we may for once accept the determination as probably accurate. The eastern limit of the extremely dry area lies near the apex of the Peninsula at Delhi, and there we see *orchidea* make its appearance, though three out of four Delhi specimens are *hirtipes*.

The *hirtipes* form also occurs at Ludhiana, north-west of Delhi. The exact provenance of these specimens is not stated, and it may be the town or the district of that name. According to Gill (1921) part of the district lies in his dry and hot ' Area IV,' the remainder, including the town, in his ' Area III,' with a 70% humidity. Whether these specimens support or discountenance the hypothesis is therefore uncertain.

South of the Kathiawar Peninsula the species passes into the northern limits of the N. Malabar area around the mouth of the Narbadda, and here also, with a rainfall of over 75″ per annum, the *orchidea* form appears, though five out of six specimens from Ahmedabad are true *hirtipes*. From Baroda, which, though further south is still beyond the Narbadda, the only specimen is of the latter form. South of Baroda *hirtipes* only maintains itself along the eastern slope of the Ghats, having been taken at Dharwar and as far south as Coimbatore. In regard to the collections from this place, out of twenty-two specimens thirteen are *orchidea* and eleven *hirtipes*, but nine of the latter were bred together. Counting all such as only one specimen, (the only possible course when captured and bred specimens are being enumerated for any statistical purpose), the proportion of *orchidea* to *hirtipes* becomes as 13 to 3. This is a further confirmation of my locating Coimbatore in the Malabar zone, though showing that affinities with the drier Carnatic are also present. South of Coimbatore *orchidea* alone occurs, passing through South Malabar into Ceylon. It also ascends the wet Nilgiri Hills nearby.

In eastern India we see a distribution typical of a species originating in Malaysia. A chain from Upper Burma through Tenasserim and into the Andamans, and another through Sylhet to the Gangetic Plain, climbing the outer ranges of the Himalaya at Kurseong and Dehra Dun, and passing down the east coast past Calcutta to Barkuda Island, in the northern limits of the Carnatic, into which it succeeds in penetrating as far as the Kistna Delta ; but as Christophers (1921) shows, there is all along the east coast of the Peninsula a seaboard strip which suggests Malayan affinities. This may be the result of a damper climate enabling infiltration from the more Malayan related areas at its southern and northern edges, or by enabling a wind-borne trans-Bay immigrant to maintain itself. To gradual infiltration from Ceylon must for the present be attributed the occurrence of *orchidea* near Ramnad, an almost desert area opposite the Island, where one would certainly expect to find *hirtipes*. Evidently the wet Palni *massif* lying between that place and Coimbatore prevented further southward spread of *hirtipes*, leaving its place in the ecology of the district free for the subsequent arrival of *orchidea*. It is also of course possible that at the period when these migrations occurred the Vaigai River had not created the low lying flats around Ramnad. However, any more certain speculations must await the obtaining of material from Tinnevelly, Trichinopoly, Madras City and North Ceylon.

Here then are two distinct chains of *orchidea* distribution. One from the Narbadda to Ceylon and probably Ramnad, the other from Upper Burma west to Dehra Dun and south to the Kistna. There is an apparently isolated third chain running from Delhi through Rohtak to Abbottabad.

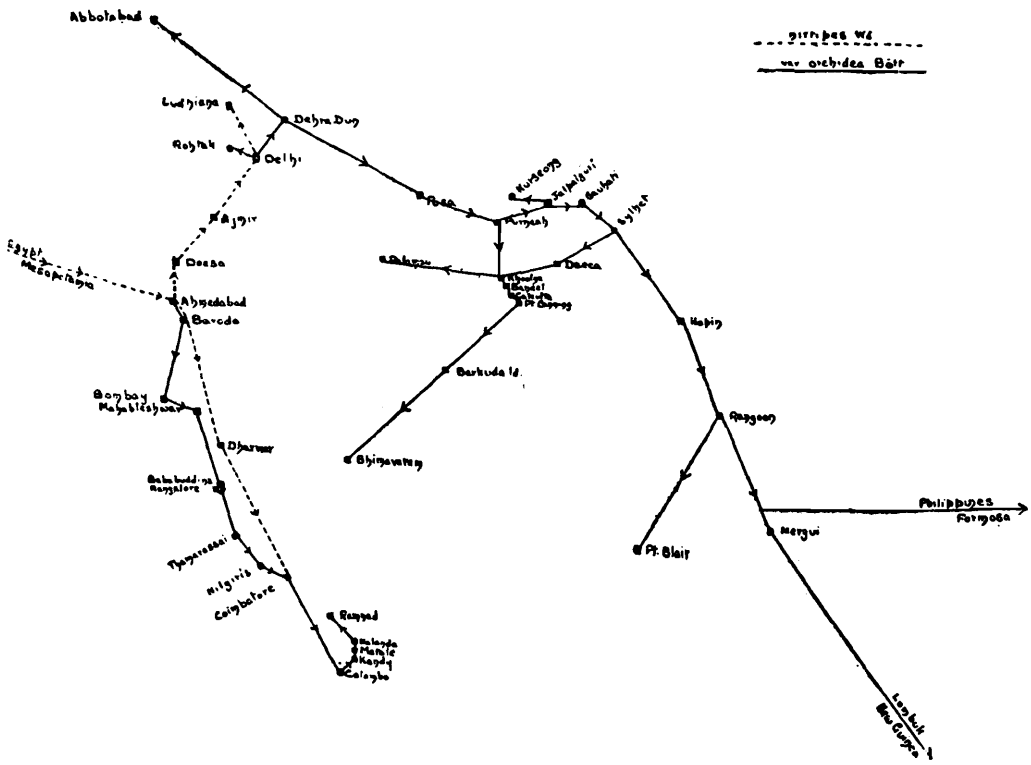
The probabilities seem to be that the *orchidea* form was developed at both limits of the Indian desert, where the tendency to vary towards a darker facies and black genital segments, and the much more fundamental lengthening of the horns of the vesica linked to the latter, (which it seems unlikely could have played any active part in the struggle for existence), found climatic conditions suitable for their propagation. The form originating on the southern edge of the desert formed the chain from the Narbadda to Ceylon, whilst that originating on the Jumna spread along the Himalayan foothills and so to the East, with a subsidiary westward chain to Abbottabad. Passing beyond India it is now found in the Philippines and Formosa, and beyond the Region in Lombok and New Guinea. Though a fairly common species it is not recorded from Malaya or Java, and the latter, at least, is a fairly well collected country. It is the commonest Oriental Sarcophagid not thence recorded. Whether the Malabar chain is really at present isolated from the eastern chain requires further collecting along the east coast from the Cauvery to the Kistna, though considering the quite large number of Guindy and Madras City specimens seen by me it must be rare along the Coramandel Coast if present at all. Equally, it must be rare in Malaya and Java. None the less, to join up the isolated chains of distribution it is very necessary that search be made to find it in the localities mentioned. That it seems rare in Malaya and Java is further support to the hypothesis of an origin remote from those countries in

North-West Peninsular India, for at first glance the facts would point to the mere overlapping of two closely allied species, one African and the other Malayan, along the Western Ghats.

Whether the two forms *hirtipes* and *orchidea* are still able to interbreed, as, in making the latter only a sub-species, I still consider possible, or whether the change in the length of the vesica horn has inhibited this and created a true species, only actual experiment can prove. At both Coimbatore and Baroda there are entomological stations, and it is greatly to be hoped that this point will be investigated.

It remains to examine whether there is anything in geological theory contrary to the foregoing hypothesis. I am not aware of any record of fossil *Sarcophaga*, but the genus *Glossina* existed in the Miocene, as shown by Cockerell (1919). This, though of a less specialized family, is a more specialized genus than *Sarcophaga*, and so we may infer with some degree of probability that the latter genus also was in existence in the Miocene. Now it was in mid-Miocene that the main Himalayan upheaval took place, (Vredenburg, 1910). Thus assuming that *Sarcophaga* arose about the same period there is nothing geological against the hypothesis. By the time that *hirtipes* reached the northern extremity of the Vindhyan system, (of Cambrian age), near Delhi, the former sea bed that is now the Gangetic Plain would have consisted only of a number of isolated basins presenting no barrier to progress towards the newly formed Himalaya to the northwards.

The suggested course of distribution is shown in the figure.



Text-fig. 1.—The Indian distribution of *Sarcophaga hirtipes*, Wd. and its sub-species *orchidea*, Bött.

S. tristylata, Bött. Only known from Formosa, its affinites seem to be more with the Palearctic than with the true Oriental forms.

S. krameri, Bött. Apparently a far-eastern species. If the Colombo record is correct then it only occurs within Indian limits in an area having strong Malayan affinities.

S. beesoni, nov. With the next species this forms an isolated group of which the only other possible member is *S. gravelyi*. Nothing can be said of its distribution, but I suspect it is another member of the shade fauna referred to under *S. walayari*.

S. pattoni, nov. Known from one locality only ; it is impossible to say anything regarding the distribution of this species either.

S. formosana, nom. nov. Known only from Formosa, the form of the aedoeagus indicates possible affinities with *S. annandalei*, but Böttcher's outline drawing is insufficient for certainty on the point. This is an instance where potash maceration has a distinct advantage over mere dry separation of the parts, and the former method should always be used for figuring a new species.

S. orientalis, Park. Recorded originally from the Philippines, and found by me in Bali material, but not in Javanese, this species would either seem to be limited to the extreme eastern edge of Indo-Malaya or else to be a wanderer from the adjacent Austro-Malayan fauna.

S. orientaloides, nov. Evidently centered in the Burmese area, this species extends through Upper Assam to Dehra Dun, and in the Malabar area from Ceylon to Bombay. It will probably ultimately be found in the Andamans and the Malay Peninsula. Eastwards it reaches Siam, and probably extends to the coasts of Annam. Collecting at Hong Kong, in Borneo, Formosa and Java alone will settle where it meets the preceding species. This would seem to be a case where a species has budded off another now fully specific in status.

S. pusana, nov. Evidently an extreme rarity, nothing can be said about its affinities and distribution.

S. crinita, Park. A Malayan species. The Carnatic locality recorded in the Tinnevelly district I cannot definitely locate, but from the Malayan nature of the name I judge it to be to the west of the district towards the Ashambu Hills, the extremities of the western Ghats, where the fauna may have a Malabar as well as a true Carnatic element.

S. khasiensis, nov. Probably another member of the shade fauna. As far as my note book shows I took the type in jungle shade, sufficiently heavy to enable several species of mosquitos to be on the wing at noon. The reappearance at the western end of the Himalaya is surprising, and leads one to suspect that it will ultimately be found all along the outer Himalayas at suitable elevations and stations.

S. futilis, nov. Possibly a species of Malayan affinities extending throughout the Indo-Gangetic Plain as far west as Dehra Dun. The isolated Ceylon localities are probably not really so, but the Nagpur capture is less easily explicable. Further collecting is needed to elucidate the distribution, and throw greater light on the probable area of origin. It is, of course, obviously related to the next species.

S. martellata, nov. I believe this species to be centered in the Carnatic, whence it extends into North Ceylon, (the South Ceylon record from Matale has never been repeated in five years and is only fourteen miles within the wet zone), and, equally sparcely, into South

Malabar and the Indo-Gangetic Plain, East. The location of Dumraon is unknown to me.

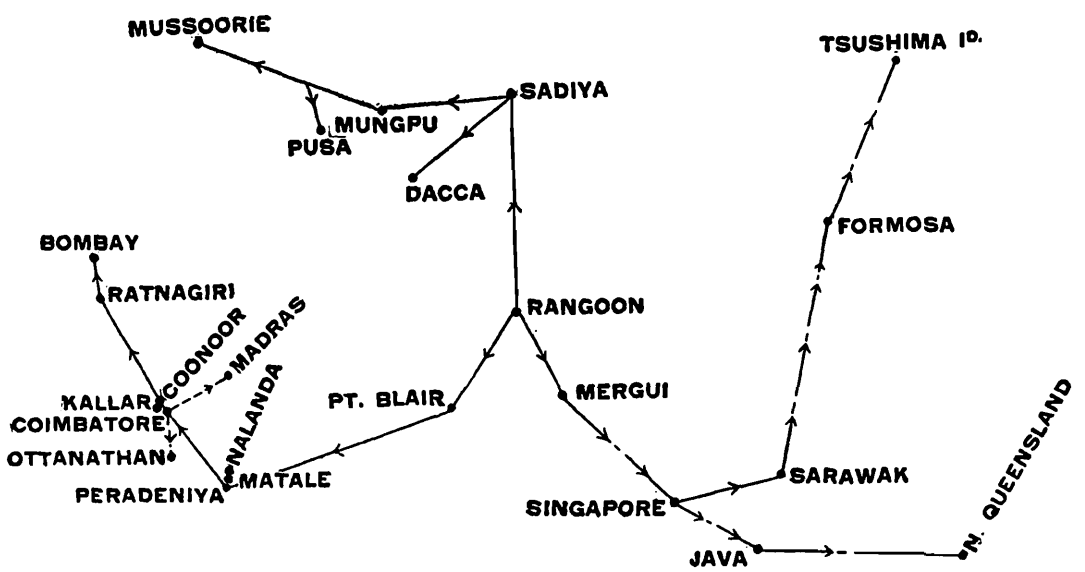
S. kempi, nov. Another Malayan species found within our limits only in the eastern plain, South Ceylon and Lower Burma. Not recorded from the Philippines, but unless bred, it seems to be rare.

S. tsushimae, nov. Probably a Palearctic species just entering the Oriental Region in the south of Japan.

S. dux, Thoms. In spite of the fact that in actual number of specimens this species surpasses all the others before me, its distribution in the Orient contains some notable hiatuses, and does not compare, for instance, with that other cosmopolite, *albiceps*. The *harpax* form is rare, but wherever careful collecting has been done this usually reveals the presence of both forms, the actual status of which only breeding experiments will show. I consider them more closely related than *hirtipes* and *orchidea*. Taking both forms together, the species is found all over the plains and as far east as Dacca, but not in the Himalaya, west or east. It appears however in Kashmir, and on the Nilgiris. Its absence from the Himalaya proper and from Burma wants the test of much more collecting before negative proof of the absence of such a known circum-terrestrial species can be accepted.

S. ruficornis, F Like the foregoing, this species appears to be absent from Burma and the true Himalaya, though the Abbottabad record tabulates as the latter; really it would pair better with the occurrence of *dux* in Kashmir, and indicate that the distribution of the two species is very similar, and that the gaps in their distribution are real, and not apparent.

S. fuscicauda, Bött. This has the typical distribution of a Malayan species entering Indian limits. It extends along the Himalaya to Mussoorie, and *via* the Andamans into North Malabar. The whole is so typical that the figure of distribution may be taken as the standard form for Malayan species.



Text-fig. 2.—The distribution of *Sarcophaga fuscicauda*, Bött.

S. fletcheri, nov. A rarity. Three out of the four records are from specially well collected localities, and it is impossible to speculate on the evidence of the captures so far made.

S. ballardi, nov. Evidently localized. These species with red antennae always attract the general collector as something unusual, and hence their absence from any fairly well searched locality acquires more signifance than in the case of obscurer species.

S. haemorrhoidalis, Meig. Purely Palearctic, and in the Orient, Himalayan. It is curious that the lowest elevation from which it is recorded, Siliguri, should be that of its eastern limit, as far as is yet known.

Turning now from the consideration of the species to that of the areas of distribution we can easily set apart certain zones as being characterized by their own species of *Sarcophagae.*

Eastern Palearctic. The eastern boundary of this zone, and of the region, is uncertain. The absence of trans-Indus collections from the N.W.F.P. is much regretted, therefore. In this zone we see *haemorrhoidalis* as a plains dweller, even as far east as Nasratabad. All the species are European, and only *falculata* shows any divergence from the type form.

Pamirs. With the exception of *khasiensis*, which is still an enigma, the fauna here is purely Palearctic also. Probably every species found in one is also present in the other zone, with the foregoing exception of *khasiensis*, which almost certainly will not pass west of the well wooded area.

Himalaya. The range can be considered as a whole. The fauna has mainly Palearctic affinities, but we can trace Oriental influences from the western limit, *orchidea* appearing at Abbottabad, and *fuscicauda* extending as far west as Mussoorie, which point also marks the eastern limit of the truly Palearctic *falculata.*

Assam. Considering the province as a whole the fauna is purely Oriental and Malayan. The hills have been inadequately collected, but none of the Palearctic species seem to cross to them though common at Darjiling. At the head of the valley some truly far eastern forms, such as *flavinervis* and *antilope*, are found.

Burma. Though obviously insufficiently collected, the affinities are purely Malayan. The hills in the north of the province almost certainly hold many discoveries yet to be made.

Bay Islands. The remarks under Burma apply. The Nicobars especially want investigation in view of the *haemorrhoidalis* 'record' therefrom.

Ceylon. Very noticeably Malayan in affinities, especially the south of the island. Whether the higher limits of the montane zone contain the two peculiarities found on the Nilgiris it will be interesting to discover.

Malabar. There are three endemic forms here in *aspinata*, *ballardi* and *walayari*. The more truly Malayan species found in South Ceylon, such as *calcifera*, *caudagalli* and *antilope*, have not been taken. The northern half of the area shows no differences from the southern, save for the absence of the endemic species. The occurrence of true *hirtipes* at Coimbatore is dealt with under that species. The Karwar jungles probably hold unrecorded, and possibly new species.

S. Indian Hills. Appear to possess two peculiar and endemic species in *gravelyi* and *pattoni*, otherwise the fauna is almost identical with that of South Ceylon.

Rajputana. Quite insufficiently collected for any useful discussion.

Indo-Gangetic Plain. The western half has been less well collected than the eastern, and in this regard it is most unfortunate that a collection specially made for me by the Government Entomologist, Punjab, went astray in transit. The western half appears to contain no peculiar species whatever, and reveals a Palearctic element in the taking of *falculata* var. *persicae* at Ambala. East of the Jumna, however, Malayan forms appear in some numbers.

Central India. Quite insufficiently collected. The records, except in the case of *futilis*, are all of species of wide distribution.

Carnatic. Contains a distinct Malayan element, possibly because nearly all the collecting has been in the region of the coast. There is apparently an endemic species in *martellata*, which spreads outwards from this centre.

Passing beyond Indian limits we enter regions where collecting has obviously been still more insufficient.

Malaya. The recorded species are all of wide distribution, and, with the doubtful exception of *krameri*, are found on both sides of the Peninsula.

Indo-China. Neither Siam or French Indo-China proper have been more than skimmed. From no far eastern locality are collections more urgently required to fill up gaps in our distributional knowledge.

Java. I feel sure that the material before me most inadequately represents this island, and trust that the publication of this paper will enable the Dutch entomologists to work out their collections and put the data these represent on record.

Philippines. These islands share with Java the distinction of possessing no peculiar species whatever.[1]

Borneo. Is the worst collected part of the whole region.

China. The few recorded species are without exact locality, and concerning them it is only necessary to call attention to the fact that *kempi*, found here, is not recorded from Formosa.

Formosa. Well collected. No less than four apparently endemic species occur. The Palearctic element again makes its appearance.

Japan. Only the southern islands seem to have been at all, and then most inadequately collected. Of the known species only *fuscicauda* shows Oriental affinities.

Austro-Malaysia. If the Wallace collections in London were worked out in the light of modern knowledge, we should have a considerable amount of information on record regarding this most interesting sub-region. All we can say on the material before me is that the area contains a few species of wide distribution passing on from the Oriental Region.

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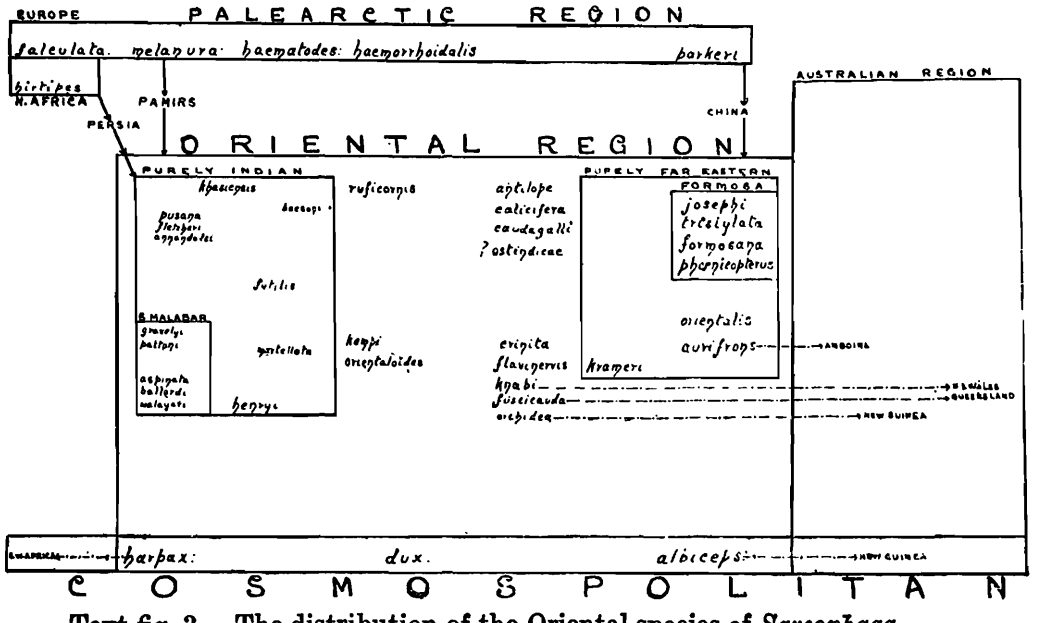
[1] Whilst this paper has been passing through the press I have had a new species, so far not known from any locality, sent me from the Philippines. I am about to describe it as *S. banksi*.

Of genera other than *Sarcophaga*, the Karachi record of *Agria nuba* Wd. reveals another North African species in the North-West corner of India. *Agria hutsoni* is an extreme rarity concerning which we can say nothing, whilst *Sarcophila cinerea* is apparently confined to sandy beaches on the Malabar, Ceylon and Coromandel coasts, its distribution being one of station and not of region.

Confining ourselves, then, to *Sarcophaga*, these results may be tabulated as below :—

	No.	%
Palearctic species	6	13·3
North-African species	1	4·4
Cosmospolitan species	3	6·7
Common throughout the Region	13	31·0
Confined to Indian limits	13	31·0
Far eastern species not reaching India ..	6	13·3
	42	99·7

Thus it appears that approximately three-quarters of the species are peculiar to the Region, the other quarter is made up of intruders from the North-west. The three really well collected areas in India show from fifteen to seventeen species each, whilst Formosa, the best collected far Eastern locality, shows fourteen, and hence it may be said with some likelihood of truth that a truly Oriental locality should contain a *Sarcophaga* fauna of fifteen to twenty species, if completely collected. These results are shown diagramatically in Fig. 3.



Text-fig. 3.—The distribution of the Oriental species of *Sarcophaga*.

NOTE.—The Palearctic species *parkeri* in this figure has been renamed *tsushimae* in the text, as the original name has been found to be pre-occupied.

X. BIONOMICAL.

In table III I have tabulated such information as the labels on the specimens seen by me have afforded under this head, together with the results of some experiments by myself. These results apply only to the genus *Sarcophaga*. Concerning *Sarcophila* and *Agria* we know nothing. *Wohlfartia* appears to contain both myiasis-causing (Sinton, 1921) and necrophagous (Patton, 1920) species.

TABLE III.—*Materials from which Sarcophaga has been bred in the Indian Sub-Region.*

Species.	Decaying vegetable matter.	Dead. mollusca	Dead insecta.	Dead non-mammal vertebrata.	Dead mammalia.	Excrement.	Parasitic on insects, etc.	Myiasis (tissue).	Myiasis (intestinal).
calicifera, Bött.	..	Gastropod'	..	..	Meat	..	..	..	..
aspinata, nov.	..	..	..	..	..	Mannure pit water.	*Acrotyla sp.*	..	..
annandalei nov.	..	*Achatina fulica*	..	..	Rabbit. Bat.	..	..	..	..
knabi, Park	..	..	..	..	Rabbit.	Human.	..	..	..
albiceps, Meig	..	..	..	..	Rabbit. Beef.	Human. Calf.	*Nonagria sp.*	Bull.	..
hirtipes, Wd.	Melon.	*Achatina fulica* [Experimentally only.]	..	..	..	Human.	..	..	Human.
pattoni, nov.	..	..	..	..	Rabbit.	..	..	..	..
orientaloides, nov.	..	*Achatina fulica*	'Grasshopper.' Sphingid larva *Lepidiota* larva	..	Beef.	Human.	Wax of Fulgorid.	..	..
martellata, nov..	..	..	..	..	..	Human.	..	..	..
kempi, nov.	..	*Achatina fulica*	Sphingid larva	..	..	..	..	..	..
dux, Thoms.	Cucumber *Cajanus indicus.*	'Oyster. ''Gastropod.' *Achatina fulica* *Indoplanorbis exustus.*	' Beetle ' *Acherontia sp.*	' toad.' ' Snake ' Eggs of *Corvus.*	Squirrel. Beef.	..	..	Human. Bull.	..
ruficornis, F.	..	*Achatina fulica* [Experimentally only.]	' Grasshopper.'	' Snake.'	Squirrel. Rat. Beef.	..	..	Dog [*apud* Sinton]	..
fuscicauda, Bött.	..	*Achatina fulica*	*Lepidiota pinguis.*	..	Rabbit. Meat.	..	Lumbricid worm.	Human.	..
fletcheri, nov.	..	..	..	..	..	Human.	..	..	..

Of the forty actual species of *Sarcophaga* now known from the Oriental Region we have no information of any kind respecting the breeding particularities of no less than twenty-six, (unless there be on record European information, not known to me, regarding the truly Palearctic species), and respecting the others, as the table shows, the information is very scanty. Though the table indicates a catholicity of taste, yet there appear to be certain definite limitations in diet.

The writer has been conducting a series of experiments, as yet far from complete, on this point. The only pabulum with which it is yet possible to speak with any certainty is the giant snail, *Achatina fulica*, which, since its introduction into Ceylon from Mauritius early in the present Century, has become an agricultural pest of first class importance. Without entering into details, which will be reserved for a separate paper, it has been found that in the Ceylon Sub-montane zone where my laboratory is situated the dead tissues of this mollusc afford a congenial diet to *dux* and its variety *harpax, fuscicauda, kempi* and *annandalei*, though this zone contains at least twice as many species as this in the genus. On one occasion *orientaloides* was also reared, whilst by placing larvae expressed from the body of the female on such material *hirtipes, orchidea* and *ruficornis* have been artificially bred up, but such material is evidently not their nidus in Nature. The action of the fore-mentioned four species in cleaning up the remains of these snails is undoubtedly beneficial, but the dirty coffee-coloured liquid left in the shells after the larvae reach maturity produces *Armigeres obturbans* in large numbers. More complete, though slower, consumption by Phoridae, mainly *Aphiochaeta* spp., and an underscribed species with apterous female, which I am describing elsewhere as *Puliciphora trisclerita*, does not engender this nuisance, but the immense numbers of *Sarcophagae* common everywhere in areas infested with this snail are in the main produced in this way. Imagines can be found in numbers flitting about on the bare earth of plantations far from any signs of faecal pollution or accumulations of rubbish by human agency. Much search and observation, however, has failed to reveal any signs of actual parasitism, though it is greatly to be hoped that such will ultimately be adopted. It will be noticed from the table that of the normal breeders in the snail, none are recorded from excrement.

Though *albiceps* is here recorded from calf dung, during the course of an as yet unpublished experiment in which I bred out the diptera frequenting this material, or rather cowdung, over a period of six months, on no occasion was a single *Sarcophaga* reared, and the occurrence must be regarded as an exception.

It will be noticed that the only species causing intestinal myiasis is also a faeces breeder, and has been reared in decaying vegetables. I suspect that the myiasis was purely fortuitous, due to accidental ingestion of already infested material.

The four species recorded as causing tissue myiasis of man and animals are *albiceps, dux, ruficornis* and *fuscicauda*. These are all common breeders in decaying carcases and meat, and are probably none of them true biontophages, but secondary on a septic condition.

Regarding the cases of parasitism of insects recorded, these must be considered doubtful, the insects may have been moribund or even dead before infestation occurred. Whether Mrs. Kemp's most interesting record of *orientaloides* feeding on a Fulgorid's waxy secretion is to be regarded as true parasitism I cannot say. The case is a strange one, for I believe this is the usual habitat of moths of the family *Epipyropidae.*

Regarding the parasitizing of a Lumbricid worm by *fuscicauda*, this result being my own I can speak with greater certainty. The worm was found after rain on the surface of a road with the prostomal region swollen and tumid. Hoping that I had obtained the life-history of a Rhiniine, or even of *Bengalia*, (the worm was of sufficient diameter to harbour the larva of any known dipteron), I caged it for developments. On the fifth day numerous immature, though third stage, larvae of *fuscicauda* emerged from between the segments of the now flaccid worm, and fed up from the outside on the remains. This recalls Keilin's (1915) results with *Onesia*, (also a Sarcophagine), in Europe.

In regard to Brunetti's rearing of *dux* from the eggs of the Indian crow, I can only suppose that the shells were cracked before the larvae gained entrance.

Fletcher (1916) records the carrying out of some chemotropic experiments by the late Mr. F. M. Howlett, in which meat was treated with various chemicals. The *Sarcophagae* obtained during this work were in the Pusa collections sent me. Only three, out of numerous sets of material, produced *Sarcophaga* :—

Meat + vanillin ..	produced *dux* only.
Meat + papain + HCl	.. produced *dux* only.
Meat + borneol ..	.. produced *dux* and *orientaloides* in approximately equal numbers.

As the control produced both species, it appears that the addition of vanillin and of papain plus HCl to the meat produced a condition inimical to the breeding of *orientaloides*. Whether this was an olfactory effect preventing the mother-fly from finding the meat, or whether, as is more likely, it was an actual rendering of the material unpalatable to the larvae, the experiment does not indicate.

As regards length of life cycle, the species bred by me seem to separate into two groups. The smaller species, with a cycle from larviposition to eclosion of imago of 18-27 days, and the larger species with a cycle of quite twice this length. To the latter belong *orientaloides* and *annandalei*, of which last one family reared by me emerged at intervals from the forty-fifth to the seventy-fourth day, and which I have never reared in less than thirty days.

The specific instability of certain forms, referred to both by Böttcher and myself, correllates well with the polyphagous habits which seem common to the genus, for as Willey (1911) states, "Hardly anything proclaims a finished organization, the culmination of a phyletic career, so plainly as an exclusive diet." Now that the great bar to experimental investigation, either genetic or bionomic, of any organism, namely indeterminability of species, has, it is believed, been removed from the genus by the publication of this paper, the writer hopes that it will receive the experimental attention that its dominance to-day merits.

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