ENTOMOLOGICA AMERICANA

A JOURNAL OF ENTOMOLOGY.

Volume XXXIV (New Series)
for 1954

PUBLISHED BY THE
BROOKLYN ENTOMOLOGICAL SOCIETY
1954

ENTOMOLOGICAL AMERICANA

Vol. XXXIV (N. S.), for 1954

CONTENTS

VOL. XXXIV (New Series)

ENTOMOLOGICA AMERICANA

A JOURNAL OF ENTOMOLOGY.

PUBLISHED BY THE

BROOKLYN ENTOMOLOGICAL SOCIETY

Published for the Society by the
Business Press Inc.
N. Queen St. and McGovern Ave., Lancaster, Pa.
Subscription, $5.00 per year
Date of issue, December 1, 1954

ENTOMOLOGICA AMERICANA

VOLUME XXXIV

THE HIPPOBOSCIDAE OR LOUSE-FLIES (DIPTERA) OF MAMMALS AND BIRDS PART II. TAXONOMY, EVOLUTION AND REVISION OF AMERICAN GENERA AND SPECIES

BY JOSEPH C. BEQUAERT

ALEXANDER AGASSIZ PROFESSOR OF ZOOLOGY,
MUSEUM OF COMPARATIVE ZOOLOGY AT HARVARD COLLEGE,
CAMBRIDGE, MASSACHUSETTS

CONTENTS

"Summa itaque oscitantia facillime ad colores revocabant veteres, sed nimium ne crede colori."

C. Linnaeus, 1751, *Philosophia Botanica,* p. 211.

INTRODUCTION

The aims and methods of this work were explained in the introduction to Part I. The preliminary sections of the present Part II discuss the taxonomy, relationships and evolution of all Hippoboscidae. They are followed by the systematic study of the American genera and species, their characters, distribution and known hosts.

The Melophaginae are not as fully treated here as the other subfamilies, the information given in my earlier "Monograph of the Melophaginae" (1942*a*) being condensed. That work should be consulted for additional references and records, detailed descriptions, bionomics, and copies of original descriptions. The distribution of the American species, however, is given completely by countries, states, or provinces.

One species in each genus is here figured in a complete dorsal view. Such figures are accurate enough for generic recognition, but are on too small a scale to show all specific characters. The detail drawings, keys and discussions of the affinities should be relied upon for identification.

Most figures were drawn by myself from pinned or alcoholic specimens, not from slide mounts. For the drawings of complete flies I have used also the artistic skill of Mrs. Richard O. Froeschner, Mrs. Stephen Marsh, Miss Patricia Washer, Dr. Fung Ying Cheng, Mr. Eustorgio Mendez and Dr. George Anastos, whose assistance is herewith gratefully acknowledged. In view of the many changes I have made to their work, it is not advisable to credit it to individual artists.

In the host lists of the several species, the numerals refer to the records from individual hosts I have verified personally. Names not followed by a numeral are included on the basis of published records mentioned in the bibliographies. Names preceded by an asterisk are of hosts introduced from the Old World by Man.

As the figures referring to American species in Part I are here cited again, the illustrations of Part II are numbered consecutively with those of the earlier part, starting with Fig. 22.

All persons and institutions who contributed material or information for my work are listed in a concluding section. At this

time I wish to express my special gratitude to the following colleagues who have spared neither time nor effort to assist me in many ways, particularly with regard to type specimens in their care: Mr. James E. Collin, Newmarket, England; Dr. F. I. van Emden, British Museum (Natural History); Dr. Richard Frey, Helsingfors Museum; Dr. H. Oldroyd, British Museum (Natural History); Mr. E. Séguy, Paris Museum; and Dr. Alan Stone, U. S. National Museum. To Dr. B. Lanza, in Florence, I owe valuable information on the present whereabouts and condition of some of Rondani's specimens. Dr. Fred Keiser, of the Basle Museum, was most helpful in arranging for the loan of Speiser's type of *Pseudolfersia mycetifera* from the Vienna Museum. I am under obligation to Dr. Graham B. Fairchild for recently examining several types at the British Museum.

I thank Mr. Kenneth MacArthur and the authorities of the Milwaukee Public Museum for permission to use the cuts of several illustrations previously published by the Museum from Mr. MacArthur's photographs. To Dr. Robert C. Murphy I owe the photograph of the head of *Phalacrocorax bougainvillii* infested with *Olfersia fossulata.*

The cost of reproduction of the illustrations in Part II was covered by the Museum of Comparative Zoology at Harvard College, to whom the author and the Brooklyn Entomological Society are greatly indebted.

GENERAL TAXONOMY

Historical Note. Linnaeus' genus *Hippobosca* (1758, **1**, p. 607) included most Hippoboscidae he was acquainted with, except the deer-ked, which he placed among the Aptera in *Pediculus* (*Op. cit.*, p. 611). His 4 species are now referred to *Hippobosca* (*equina*), *Ornithomyia* (*avicularia*), *Stenepteryx* (*hirundinis*), and *Melophagus* (*ovina*). It is remarkable that he recognized the kinship of the sheep-ked with the louse-fly of the horse, while missing that of the deer-ked.[1] The true affinities of the deer-ked were first noted by Olivier (1792, p. 92), who described it as a new species of *Hippobosca* (*cervi*), without citing Linnaeus' *Pediculus cervi.*

No further progress was made with the taxonomy of the louse-flies until Latreille proposed (1802, **2**, p. 365) to place *Hippobosca* in a special order, the Coleostoma, fully on a par with the order

[1] Massonnat's (1909, p. 13) statement that Linnaeus placed *Lipoptena cervi* in *Melophagus* was corrected later (1909, p. 228).

Diptera. But he soon modified this view (1802, **3**, p. 465; 1805, **14**, p. 397) and introduced the term "Coriacées, coriaceae" for his 98th family of Insects (his 12th family of the Diptera). This formed by itself the 2nd section of the Diptera, the remaining 11 families being the 1st section. It comprised *Hippobosca, Ornithomyia, Melophagus* and *Nycteribia,* the last-named 3 genera proposed anew, so that it was a mixture of nycteribiids and true hippoboscids. A few years later (1809, **4**, pp. 243 and 360–364) Latreille clearly recognized the nycteribiids and hippoboscids as distinct taxonomic units, the latter being his tribe "Eproboscidea" (with the family "Coriaceae") and the former his tribe "Phthiromyiae" (without family name); all remaining Diptera formed his third tribe, the Proboscidea (p. 238). At the same time he gave a surprisingly detailed and correct definition of the Coriaceae (our hippoboscids), a durable milestone in the history of the group.

The first use of the term "Pupipara" for a taxonomic concept also dates from Latreille (1817, **3**, p. 650), who proposed it to cover all the so-called pupiparous ectoparasitic Diptera known to him. It included both hippoboscids and nycteribiids, the term being exactly equivalent to his earlier "Coriaceae" (1802 and 1805). In a later edition of the same work (1829, **5**, p. 538), he reverted partly to his system of 1809, his family "Pupipara" being now divided into 2 tribes: the "Coriacés" for the known hippoboscids, but with the addition of *Strebla;* and the "Phthiromyies" for the known nycteribiids.

Leach's Omaloptera (1817, **3**, p. 60), emended to Homaloptera by Macleay (according to Westwood, 1840, **2**, p. 581), included only hippoboscids according to the original definition; but Curtis (1824, **8**) extended it to the nycteribiids also. The Hippoboscina of Newman (1834, pp. 379 and 396) included hippoboscids, nycteribiids and *Carnus.* Westwood's Thoracocephala (1840, **2**, Gen. Synopsis, p. 154, for the Hippoboscidae and Nycteribiidae), Blanchard's "Ornithomyens" (1840, **3**, p. 630), Bigot's "Cryptocères" (1852, p. 483) and "Anomalocerati" (1885, p. 226), Rondani's Hippoboscita (1875, p. 464; 1878, p. 150; 1879, p. 31), and Townsend's superfamily Hippoboscoidea (1935, **2**, p. 81) all correspond more or less to Latreille's Pupipara, but sometimes with the intrusion of extraneous elements (such as *Braula, Carnus,* and in the case of the Anomalocerati even parasitic Hemiptera).

Townsend (1935, **2**, p. 81) adopted the term Nymphipara for a subsection of the Diptera Schizophora comprising only his superfamily Hippoboscoidea. Presumably he followed Müggenburg

(1892, p. 292) who thought that Réaumur had used the term for a taxonomic unit, thus antedating Latreille's Coriaceae of 1802 and Pupipara of 1817. However, Réaumur (1742, **6**, p. 590) merely pointed out that his so-called spider-flies (our Hippoboscidae) added a third reproductive type or class, the nymphiparous insects (cited in the French vernacular only), to the two reproductive types or classes of animals known before, namely the viviparous and the oviparous. The wording of the text shows clearly that he did not intend to propose a new taxonomic unit in the Diptera.

The use of the term Hippoboscidae in its present form for the true louse-flies seems to date from Curtis (1824, **8**, letterpress to Pl. 14 of *Haemobora pallipes,* dated March 1, 1824), although he credits it to Leach in the text to Pl. 122. He applied it to one of the two families of his order Omaloptera, the other being called the Nycteribidae. A few years earlier, however, Billberg (1820, p. 123) had called "natio Hippoboscaedes" a group comprising *Hippobosca, Ornithomyia* and *Melophagus.* Newman's (1834, pp. 379 and 396) "natural order Hippoboscites" is another slight variant for the same concept.

The substitute Ornithomyiidae for Hippoboscidae, first introduced by E. Blanchard in the French vernacular "Ornithomyides" (1868, *Métamorphoses et Mœurs des Insectes,* p. 657) and given in the Latin form Ornithomyidae by J. Wagner (1903, *Horae Soc. Ent. Rossicae,* **36**, p. 127), is very rarely used.

Family Characters. It is often difficult to draw up workable definitions of families or other higher categories, particularly among the Diptera where "annectant forms" are notoriously frequent. This is fortunately not true for the Hippoboscidae, which are one of the most sharply delimited groups of insects.

The Hippoboscidae are dorso-ventrally flattened Diptera Cyclorrhapha with many of the essential characteristics of the higher Muscoidea. The flattening is particularly pronounced for the robust head and thorax, both encased in an unusually tough, strongly sclerotized integument. The head, directed forward in a near-horizontal position, is wedge-shaped and sharply divided dorsally by the ptilinal suture into an upper vertex (consisting of postvertex, inner orbits and mediovertex) and a lower frons, both on the same plane. The frons is more or less widened, either at the upper lunula only or also over the apical interantennal portion (facial carina). The clypeus is very small, placed in the basal connecting membrane of the proboscis, beneath the apical edge of the frons. The antennae are inserted close to the oral margin, at

the sides of the frons, usually in two separate pits which are either open anteriorly or completely surrounded by a rim; exceptionally (*Ornithoica*) they occupy a single pit. Although variable in size and shape, the antennae are always flattened and modified in the same way: the first segment tends to be reduced and to fuse more or less with the sides of the lunula, being large and fully separated in *Ornithoica* only; the second segment, often but not always with a longitudinal apical slit on one side, is enlarged, sometimes in a long appendage; it is hollowed out apically into a deep cavity, which contains and hides the very small third segment bearing a short arista. Compound eyes are well developed, large or small, with many, normally shaped, small ommatidia, and separated in both sexes by a broad face. The ocelli may be large, rudimentary or absent. The maxillary palpi are usually distinct (rudimentary in *Echestypus* only), one-jointed, flattened, enclosing the haustellum at rest within their concave inner surfaces. The mouth-parts (Figs. 7*A–D*) are modified into a proboscis adapted to piercing the skin and sucking the blood of vertebrates: a thin, straight, needle-like haustellum comprises the closely joined labium, labrum-epipharynx and hypopharynx; it is swollen at the base into a ventral bulb and may be retracted in and protruded from a soft rostrum membrane at the under side of the head capsule; the haustellum ends in two very short labella (modified labial palpi) bearing rows of prestomal cutting teeth (Figs. 6*A–B*); it is moved by muscles inserted on a tentorium which comprises a hyoid. In the act of biting, the very long, slender portion of the haustellum (including most of the labium) enters the skin as far as the bulbous base. The depressed thorax is equally developed and sclerotized dorsally and ventrally; a broad sternal area extends on the sides of the median (internal) cryptosternum (characteristic of all Diptera) and separates the mid from the hind coxae, as well as the two coxae in each pair; it is much less developed between the fore coxae. The upper lateral areas (pleuro-notal sclerites) of prothorax and mesothorax are dorsal and horizontal, on a plane with the notum, the prothoracic spiracles being dorsal or dorso-lateral. A scutellum is always set off, followed by a well-developed postscutellum, the narrow area between them (subscutellum) being usually membranous. Metathoracic spiracles are present. The robust legs, inserted at the side edges of the sternum and spread out more or less horizontally, move sideways as well as forward and backward; they end in two claws, each with a heavy basal heel and a simple or deeply cleft tip. Halteres are usually present,

except in *Melophagus*. The wings may be normal and functional or reduced in size and functionless, sometimes temporarily functional, completely rudimentary in *Melophagus* only. When most complete, the venation is essentially that of the higher Muscoidea, except for the lack of a discoidal cross-vein closing a discal cell; some of the other cross-veins and more rarely some of the longitudinals are missing in certain genera. The alula is present or absent. The wing membrane is often covered to some extent with microscopic hairs (microtrichia). Calypteres are either present but reduced, or absent; they never cover the halteres. The integument of the moderately flattened abdomen is mostly soft and extensible, as a rule with few or reduced dorsal sclerites (except in *Ornithoica*), ventrally with only a median basal sclerite and sometimes a pair of preänal sclerites. The male terminalia are extremely simplified, consisting at most of a pair of gonocoxites and an aedeagus of 3 rod-like pieces (2 penis valves surrounding the penis); the gonocoxites may be broad, flap-like (*Olfersia, Lynchia*), reduced to narrow, short, finger-shaped processes (*Ornithomyia, Ornithoctona*), rudimentary as minute knobs (*Ornithoica*), or absent (*Stilbometopa*). Seven pairs of abdominal spiracles have been traced in most genera and are probably present in all. The body is moderately to strongly hirsute, the bristles often long and stiff; but there are never true ctenidia of short, peg-like spines. The usual muscoid chaetotaxy is present to some extent, but often obliterated by additional setae; the head bears distinct orbital and vertical bristles. There are no functional spermathecae. Reproduction is by completely intra-uterine or adenotrophic viviparity (so-called "pupiparity"), one larva developing at a time in the uterus, where it is fed by special milk-glands. After leaving the female's body, the 3rd larval instar is motionless, takes no food and hardens the integument at once into a puparium, which opens by means of a splitting cap, as in all Cyclorrhapha, when the adult emerges. Both sexes are obligate, nearly permanent, intermittently blood-sucking ectoparasites of mammals or birds; none live on bats. The blood is stored mostly or only in the digestive tract proper, the one oesophageal diverticulum being much reduced and either wholly or partly functionless.

Other structural features, sometimes mentioned as characteristic of the Hippoboscidae, occur only in certain specialized types. They are nevertheless of sufficient interest to retain our attention, since they are found more often in this family than elsewhere. Furthermore, they point to definite evolutionary trends which

often culminate in structures functioning as extreme adaptations to permanent ectoparasitism. Indeed, there are few features of the Hippoboscidae not correlated in some way with the structure or behavior of the hosts. Massonnat (1909) first called attention to this in a detailed discussion of hippoboscid morphology, which contains many useful suggestions, although it was based only on a few Palearctic genera and species. The value of his observations is somewhat impaired, moreover, by his including for comparison the Nycteribiidae, only remotely related to the Hippoboscidae, and the Braulidae, not related with them at all.

The cover of hairs and bristles varies greatly and marked hirsuteness is not common enough to be a family character. Usually the setae or hairs are scarcely more developed than in many free-living, non-bloodsucking Diptera. In some cases (*Ornithoctona*) the thoracic dorsum is almost bare. The setae tend to be stiff and long. Hirsuteness is particularly pronounced in most subapterous and apterous flies of both birds (*Crataerina, Myiophthiria*) and mammals (*Melophagus*) giving them the appearance and physical properties of a burr, which helps keep the flies in the plumage or pelt. In addition, the costa of the wing remnants of the subapterous flies bears many stiff, long bristles, serving the same purpose, so that the rudimentary wings are not wholly functionless.

The structure of the head is uniform throughout the family, except for minor points, such as the relative length of frons and vertex or the extent of the postvertex. Usually a soft mediovertex occupies the middle of the face; but in *Olfersia* it is mostly obliterated by the downward extension of the sclerotized postvertex, thus increasing protection against crushing. Massonnat (1909, pp. 23–27) attempted to correlate the relative length of the head with the degree of permanency on the host. Although he used for comparison the total length (including the abdomen), a meaningless measurement in the Hippoboscidae as it varies constantly during life, his general conclusion remains true. In the fully-winged species (*Hippobosca, Lynchia, Ornithoica, Stilbometopa, Ornitheza, Olfersia, Ornithomyia, Ortholfersia, Ornithoctona*) the head is relatively shorter (particularly as compared with the thorax) than in the subapterous and apterous forms (*Stenepteryx, Crataerina, Myiophthiria, Melophagus*). Moreover, in the species of *Ornithomyia* which are specific parasites of swallows (*O. biloba, O. fur, O. inocellata*) and have relatively shorter wings than usual in the genus, the head is proportionately longer than in those with a wide range of other types of hosts and with longer wings (*O. avicularia,*

O. parva, O. fringillina).[2] The head of *Allobosca,* known at present only from specimens with short wing stumps, is about as high as wide, but relatively short as compared to the thorax; this feature suggests the possibility that *Allobosca* may be fully-winged upon emergence and lose most of the membrane after reaching the host.

The compound eyes, as a rule large and mostly dorsal, always comprise many normally shaped, small ommatidia. Massonnat (1909, pp. 43–46) noted a definite correlation between the length of the wings and the size of the eyes, the subapterous and apterous species having much smaller eyes than the fully-winged forms. Thus, among the mammal-flies, in the permanently winged *Hippobosca* the eye covers $\frac{2}{3}$ of the dorsal surface of the head, in the wingless *Melophagus* only 1/9, and in the temporarily winged *Lipoptena* $\frac{1}{4}$. Among the bird-flies also, the eyes are small in the subapterous *Stenepteryx, Crataerina* and *Myiophthiria.* As *Allobosca* has eyes as large as any of the fully-winged bird-flies, it may again be surmised that it is not truly subapterous.

The ocelli vary in a somewhat haphazard manner, but with a decided tendency to disappear. Sometimes they are so unstable that their presence or absence carries little weight as a generic or even specific character. Among the mammal-flies, 18 species in 2 genera are with, and 16 species in 6 genera without, ocelli. They are absent in nearly $\frac{2}{3}$ of the bird-flies (50 species in 7 genera) and present in slightly over $\frac{1}{3}$ (38 species in 6 genera). Furthermore, while ocelli are usually distinct in *Ornithomyia,* in some species they are small or rudimentary (*O. inocellata*); in two species they have disappeared completely, *Pseudornithomyia* being originally proposed as a genus for one of these; but both these species agree with *Ornithomyia* in every other generic character, so that I regard *Pseudornithomyia* as a subgenus only. On the other hand, *Lynchia* normally lacks ocelli; exceptionally they are more or less developed, one such species being the type of *Ornithophila;* but again this is at best a subgenus, as all other characters are those of *Lynchia.* A few other genera which I now recognize seem to differ essentially only in the presence or absence of ocelli (*Crataerina* and *Stenepteryx; Lipoptena* and *Echestypus*), and these too may eventually be combined.

[2] Massonnat's measurements of *O. avicularia* and *O. fringillina* are unreliable, as he failed to recognize these species properly and even confused *O. biloba* with *O. fringillina.*

In most hippoboscids the lower part of the frons (frontal carina of the Myiodaria) is greatly widened, flattened or slightly convex, between the antennal pits. In *Ornithoica,* however, it is restricted to a smaller upper area, below the lunula, the twin basal segments of the antennae occupying a single facial cavity and touching each other on the middle line. All other genera have the two antennae widely separated in individual antennal pits. The anterior or oral margin of the frons is either entire (straight or curved outwardly) or more or less notched and divided in lateral lobes or prongs.

The variations in size and shape of the antennae were discussed in Part I (pp. 25–27). I pointed out that a furrow is present on the 2nd antennal segment in some genera and absent in others. It is most prominent in the Ortholfersiinae, in which the cavity of the 2nd segment (enclosing the 3rd) is also more open at apex than in other hippoboscids. I described several types of antennal arista. It may be of significance that the antennae are small or very small in nearly all mammal-flies (except *Allobosca* of lemurs) and large in the bird-flies (except *Hippobosca struthionis*). In some of the latter (*Ornithoctona, Stilbometopa*), the 2nd segment is enlarged into a flattened, leaf-like appendage. Massonnat (1909, pp. 48–51) was unable to correlate the size of the antennae in the mammal-flies with the degree of permanency on the host. In the bird-flies, however, he thought that the antennae became longer and more bristly with increased obligate ectoparasitism, as deduced from the decreasing size of the wings. A comparison of *Ornithoctona* (with very long antennae) and *Ornithomyia* (with short antennae), both fully-winged and mobile, on the one hand, with *Stenepteryx* and *Crataerina* (with relatively short antennae), both subapterous and narrowly host-bound, on the other, scarcely supports his conclusion.

The thorax and its appendages offer the most striking changes associated with different types of hosts. Some of these were discussed in Part I (pp. 31–50) and also by Massonnat (1909, pp. 21–30 for the relative size of the thorax; pp. 56–106 for the wings and legs).

In general the dorso-ventral flattening of the thorax of the mammal-flies is less pronounced in the fully-winged forms (*Hippobosca* and Ortholfersiinae) than in those that drop the wings (*Lipoptena, Neolipoptena,* and *Echestypus*) or are permanently apterous (*Melophagus*). It is never as marked in these flies as in some of the bird-flies, in which, moreover, it varies considerably,

being only slight in the Ornithoicinae (*Ornithoica*), moderate in most genera of Ornithomyiinae, and extreme in *Stilbometopa* and *Olfersia*. Its development seems to be correlated with increasing body size rather than with fixity on the host (as expressed by the size of the wings) or with the type of host. In the subapterous *Crataerina* and *Myiophthiria* the thorax is not noticeably more depressed than in some of the fully-winged flies.

The meta-basisternum is sometimes produced on each side over the hind coxa as a flat, retrograde *metasternal tooth* or spur; these teeth are not correlated with the type of host. They are a generic feature of *Stilbometopa* (where they are long), *Pseudolynchia* and *Ornitheza* (where they are short); in *Lynchia* they are present in a few species, but absent in most; the other genera lack them entirely.

The relative length of the thorax is more clearly correlated with the degree of permanency on the host. In all Hippoboscidae the dorsum of the thorax is wider, as compared with its length (from the anterior margin to the hind margin of the scutellum), than in most free-living Diptera. Massonnat concluded that, in both the mammal-flies and the bird-flies, the thorax was conspicuously shorter in the subapterous and apterous species than in the more mobile, fully-winged forms. Although based on an inadequate comparison of thorax length with total body length (an unreliable measurement), his conclusion nevertheless holds. Indeed, it becomes more evident if the proportions of thorax length to thorax width are compared. Among the mammal-flies, the thorax is about as long as wide or at most $\frac{1}{4}$ wider than long in the fully-winged genera, such as *Hippobosca, Ortholfersia* and *Lipoptena;* whereas it is about twice as wide as long in the apterous *Melophagus*. The thorax of *Allobosca* is proportioned about as in *Lipoptena,* which again suggests that *Allobosca* is possibly not truly subapterous. Among the bird-flies the differences are even more instructive. In the fully-winged forms, such as *Ornithoica, Ornithomyia, Ornithoctona, Stilbometopa, Ornitheza,* etc., the thorax is from $\frac{1}{4}$ to $\frac{1}{3}$ wider than long; but in the subapterous *Crataerina, Stenepteryx* and *Myiophthiria* the thorax is only about $\frac{1}{2}$ as long in the middle as wide, or even less. This shortening is, however, counteracted in the bird-flies by the lengthening of the humeral callosities into forward projecting, pointed lobes which extend along the sides of the head. None of the mammal-flies have pointed humeral callosities, the anterior corners of the thorax being rounded off and moderately or not projecting, even in *Melophagus* where the anterior

margin of the thorax forms a rather deep inward curve. Among the bird-flies, only *Ornithoica* has the anterior margin nearly straight, with very short, scarcely projecting humeral callosities. In all the Ornithomyiinae the humeri project forward as bluntly pointed lobes; these are relatively short in the fully-winged forms, although they are much more pronounced in *Ornithoctona, Olfersia* and *Stilbometopa* than in *Ornithomyia, Ornitheza, Lynchia* and *Pseudolynchia;* they are unusually long and often slender in the subapterous *Crataerina, Stenepteryx* and *Myiophthiria.* They add greatly to the streamline shape of the flattened body and it is therefore interesting to note that they are most highly developed in the flies of swallows and swifts, a point which will be considered again later. In this connection, within the genus *Ornithomyia* the species which are strict parasites of swallows have longer and more pointed humeral callosities than those with a wide range of other bird hosts.

The size of the wings is clearly correlated with the type of preferred hosts. Among the bird-flies, the fully-winged forms use as breeding hosts less specialized types of birds; but the subapterous forms are restricted to swallows (Hirundinidae) and swifts (Apodidae), mainly aërial, fast-flying birds often nesting in colonies. The trend toward the flightless condition is more general among the mammal-flies, athough the Hippoboscinae and Ortholfersiinae are fully winged and active, though slow fliers. Most other mammal-flies either have wings reduced to functionless pads (Allobosciinae of lemurs) or drop the wings upon reaching the permanent host (most Melophaginae of Artiodactyla). Finally the two species of *Melophagus,* of sheep and chamois, are completely wingless, the wings being reduced to minute rods. There is also a tendency throughout the family to reduce the venation by loss of veins, even in some fully-winged forms. It is, of course, more pronounced in the subapterous forms and even more so in the Melophaginae which use the wings only for a short time after emerging.

The legs are always well-developed and powerful. In the bird-flies they tend to become longer and more slender, particularly on the tibiae, tarsi and claws. This trend is most pronounced in the spider-like flies of swifts and swallows (*Crataerina, Stenepteryx* and *Myiophthiria*). Among the mammal-flies the tendency is in the opposite direction, producing the shorter and thicker legs of the Melophaginae and culminating in the greatly swollen femora and tibiae of *Allobosca.* However, this tendency is much less marked in the Ortholfersiinae and Hippoboscinae, whose legs are scarcely

shorter and thicker than those of some of the bird-flies, such as *Stilbometopa*. It is interesting to note that among the mammal-flies thicker and shorter legs are correlated with the loss or impairment of the power of flight; but the reverse is true among the bird-flies, where the subapterous forms have the longest and most slender legs.

Subfamilies and Tribes of Hippoboscidae. The Hippoboscidae are so poorly represented in the average regional fauna that little need has been felt to subdivide them above the generic level. Even on a world-wide basis they comprise in my opinion only 20 groups entitled to generic rank. A comparative study of the genera, particularly from the point of view of their possible origin and evolution, shows nevertheless that they belong to several secondary lines of descent, sufficiently distinct for recognition as subfamilies.

The only previous attempt at a supra-generic grouping, by Speiser (1908*c*, p. 445), recognized the subjoined five subfamilies, an arrangement adopted by Brues and Melander in their "Classification of Insects" (1932, *Bull. Mus. Comp. Zool.*, **73**, p. 347; 1954, *Op. cit.*, **108**, p. 386).

a. Olfersiinae. Hippoboscidae without ocelli, always with well-developed wings, without closed anal cell; pronotum not visible dorsally. Genera: *Ortholfersia, Olfersia* (now called *Lynchia*), *Icosta* (now included in *Lynchia*), *Lynchia* (now called *Pseudolynchia*), and *Pseudolfersia* (now called *Olfersia*).

b. Hippoboscinae. Hippoboscidae without ocelli, with well-developed wings, without anal cell; pronotum visible dorsally as a swelling; usually brightly colored. One genus: *Hippobosca*.

c. Alloboscinae. Hippoboscidae without ocelli, with rudimentary wings in which the posterior basal cross-vein ("Analader") is sufficiently developed and curved upward to seem to delimit an anal cell. One genus: *Allobosca*.

d. Lipopteninae. Hippoboscidae some with, others without ocelli, at most with weak wings with greatly reduced venation, the wings either dropped except for stumps or reduced to scarcely visible knobs. Genera: *Lipoptena, Echestypus*, and *Melophagus*.

e. Ornithomyiine. Hippoboscidae either with or without ocelli, with functional or rudimentary wings, which usually have retained the anal cell; but the species without anal cell always have ocelli and those without ocelli either have an anal cell or no longer a distinct venation. Genera: *Ornithoica, Ornithomyia, Stenepteryx, Ornitheza, Ornithoctona, Ornithopertha, Ornithophila* (now included in *Lynchia*), *Crataerina, Myiophthiria, Brachypteromyia*, and *Stilbometopa*.

My "Monograph of the Melophaginae" (1942*a*, pp. 37–38) recognized six subfamilies and I follow here the same arrangement. Only the Melophaginae were characterized thus far (*loc. cit.*). All six subfamilies are here defined on a comparative basis and their genera listed.

Only the Hippoboscinae, Alloboscinae and Lipopteninae are kept with Speiser's limits. I prefer to call the third subfamily Melophaginae, as Bezzi (1915, p. 177) suggested, deriving the name from the oldest and best known genus of the group. Speiser's Olfersiinae and Ornithomyiinae are composite groups and do not bring out the true affinities of the genera he included. Both *Ortholfersia* (placed by Speiser in Olfersiinae) and *Ornithoica* (placed by Speiser in Ornithomyiinae) are isolated genera, each of which I place in a distinct subfamily. The remainder form my subfamily Ornithomyiinae. In characterizing the subfamilies I stress the structure of frons, antennae and tarsal claws, characters not mentioned by Speiser, and attach less importance to the ocelli and venation.

1. **Ornithoicinae.** Visible area of frons restricted to the lunula and a very small, triangular, median sclerite adjoining the antennae, the twin basal antennal segments touching each other over most of their length (Fig. 24*G*). Both antennae protruding from a single facial pit; 1st segment large, completely divided from the lunula. Anterior margin of frons undivided. Thorax moderately flattened; prescutum with a nearly straight antero-dorsal margin and barely projecting, broadly rounded humeral callosities; protergum not visible dorsally; notopleuron completely separated from prescutum; basisternum of prosternum undivided (Fig. 12*B*). Tarsal claws simple, but with prominent basal heel (Fig. 24*E*). Dorsum of abdomen extensively covered by large median sclerites. In addition: ocelli present; prothoracic spiracles placed dorsolaterally on the humeral callosities; wings functional, with the complete venation of the family (three cross-veins), a well-developed alula, but rudimentary calypteres. One genus, *Ornithoica*, parasitic of birds, world-wide, with a few species (6 or 7).

2. **Ornithomyiinae.** Lunula and interantennal part of frons both well developed, the twin first antennal segments separated throughout by a flat, narrow or broad frontal carina. Each antenna protruding from its own pit (Fig. 5*A*); 1st segment small, incompletely divided from or fused with the side of the lunula. Anterior margin of frons divided into two apical lobes or prongs. Thorax (Figs. 8*A*, 9*A*, and 10*A*) much flattened; prescutum with an incurved anterior margin and distinctly projecting humeral

callosities; protergum not, or narrowly, visible dorsally; notopleuron either separated from or more or less fused with prescutum; basisternum of prosternum divided into two anterior lobes or prongs. Tarsal claws bifid, in addition to the strong basal heel which makes them appear tripartite (Fig. 12*K*). Median dorsal sclerites of abdomen either much reduced or mostly lacking. In addition: ocelli present, vestigial or absent; prothoracic spiracles placed dorsally; alula moderately large or rudimentary; calypteres small or rudimentary. Wings either fully developed, the venation varying with the genus, or more or less reduced in size and non-functional. The largest subfamily, world-wide, with 11 genera, all parasitic of birds.

These genera are so similar in all essential characters that they must be modifications of a single original ancestral stock. Nevertheless, one of them, *Olfersia,* is isolated from the others by the peculiar structure of the frons, warranting a further subdivision into two tribes.

2*a*. **Tribe Ornithomyiini.** Frons divided by a transverse suture or depression into an upper, broad lunula and a lower, much narrower interantennal area (Figs. 4*A, D,* and *F,* and 5*A*). Frons and postvertex separated by a long, soft mediovertex. The 10 genera included seem to form 3 fairly natural groups as follows:

Ornithomyia (including *Pseudornithomyia;* 12 species), *Ornitheza* (1 or 2 species), *Crataerina* (about 7 species); *Stenepteryx* (1 species), and *Myiophthiria* (including *Brachypteromyia;* 4 species). Appendage of 2nd antennal segment short and narrow, extending little beyond the rim of the pit. Wings either fully developed and with complete venation or more or less reduced and with some of the veins or cells coalescent.

Ornithoctona (including *Ornithopertha;* 9 species) and *Stilbometopa* (5 species). Appendage of 2nd antennal segment very long and broad, leaf-like, extending much beyond the rim of the pit. Wings fully developed and with complete venation.

Lynchia (including *Icosta* and *Ornithophila;* about 30 species), *Pseudolynchia* (3 species), and *Microlynchia* (3 species). Appendage of 2nd antennal segment short and narrow, extending little beyond the rim of the pit. Wings fully developed, but with incomplete venation, lacking either the posterior basal or both basal cross-veins.

2*b*. **Tribe Olfersiini.** Frons forming one undivided sclerite, the very broad interantennal area completely fused with the lunula (Fig. 7*F*). Sclerotized postvertex covering most of mediovertex

to near ptilinal suture. Appendage of 2nd antennal segment short and narrow, extending little beyond the rim of the pit. Wings fully developed, with incomplete venation, lacking the posterior basal cross-vein.[3] One genus, *Olfersia* (7 species).

3. **Hippoboscinae.** Interantennal portion of frons (Fig. 5*B*) broad, forming a flattened area completely fused with the lunula. Antennae very small, each in a deep, complete, rimmed pit; 1st segment completely fused with the side of the lunula. Anterior margin of frons deeply divided into two apical lobes. Thorax (Figs. 11*C–E*) moderately flattened, with a nearly straight anterior margin and broadly rounded, not projecting humeral callosities; protergum well developed, distinctly visible dorsally; notopleuron completely fused with prescutum; basisternum of prosternum undivided. Tarsal claws simple, but with prominent basal heel (Fig. 12*F*). Median dorsal sclerites of abdomen mostly lacking. In addition: ocelli lacking; prothoracic spiracles latero-dorsal; wings fully developed, without closed anal cell; with broad alula and distinct calypteres. One genus, *Hippobosca* (8 species), restricted to the Old World and parasitic of mammals, except for *H. struthionis* of the ostrich.

4. **Alloboscinae.** Interantennal part of frons very broad, forming a flat median area fused with the lunula (Fig. 5*D*). Appendage of 2nd antennal segment large, extending considerably beyond the pit; 1st segment mostly fused with the side of the lunula. Anterior margin of frons divided into two divergent lobes. Thorax moderately flattened, with a slightly incurved anterior margin and broadly rounded, moderately projecting humeral callosities; protergum very narrowly visible dorsally; notopleuron completely fused with prescutum; basisternum of prosternum undivided. Legs very short and thick; claws simple, but with prominent basal heel. Median dorsal sclerites of abdomen mostly lacking. In addition: ocelli absent; prothoracic spiracles latero-dorsal; wings reduced to short, non-functional pads with incomplete venation (Fig. 12*I*); no alula and no calypteres. One genus, *Allobosca* (1 species), parasitic of mammals (lemurs) and restricted to Madagascar.

5. **Ortholfersiinae.** Interantennal part of frons broad, form-

[3] At one time I was inclined to place *Olfersia* in a subfamily of its own, which explains the use (at my suggestion) of the term Olfersiinae by de Buen (1950, p. 315). Except for the peculiar face, *Olfersia* is, however, essentially one of the Ornithomyiinae and to all appearances derived from the same stock.

ing a flat median area, fused with the lunula. Antennae small, partly protruding from the pits; 1st segment short, distinctly divided by a suture from the lunula; 2nd segment with a long lateral furrow, the cavity containing the 3rd segment broadly open. Anterior margin of frons very broadly emarginate, the sides produced as narrow, ridge-like prongs. Thorax moderately flattened, with a nearly straight anterior margin and broadly rounded, slightly prominent humeral callosities; protergum not visible dorsally; notopleuron completely fused with prescutum; basisternum of prosternum very broad, undivided. Legs stout; femora swollen; claws simple, but with prominent basal heel. Median dorsal sclerites of abdomen mostly lacking. In addition: ocelli absent; prothoracic spiracles latero-dorsal; wings well-developed and functional, with only two cross-veins (no closed anal cell) and with or without 2nd longitudinal vein (Figs. 14*B–C*); alula well-developed; calypteres rudimentary. Two genera, both parasitic of mammals (Marsupialia) and restricted to Australia: *Ortholfersia* (3 or 4 species) and *Austrolfersia* (1 species).

6. **Melophaginae.** Interantennal part of frons very broad, forming a flat median area fused or nearly fused with the lunula (Fig. 4*C*). Antennae small, each in a deep, rimmed pit; 1st segment completely fused with the side of the lunula. Anterior margin of frons convexly curved, entire except for a trace of a median notch at the end of a longitudinal impressed line or furrow. Thorax (Figs. 11*A–B*) much flattened; prescutum with a slightly incurved anterior margin and barely projecting, broadly rounded humeral callosities; protergum distinctly visible dorsally in the winged forms, fused with the prescutum in the wingless *Melophagus;* notopleuron fused with prescutum; basisternum of prosternum divided into two widely separated lobes. Legs short and thick; claws simple, but with prominent basal heel. Median dorsal sclerites of abdomen more or less developed (*Lipoptena* and *Echestypus*) or absent (*Neolipoptena* and *Melophagus*). In addition: ocelli present or absent; prothoracic spiracles placed dorsally; wings absent in *Melophagus,* temporarily present and functional in the other genera, but with greatly reduced venation; no alula and no calypteres. Nearly world-wide, with 4 genera, parasitic of mammals (Artiodactyla).

The completely apterous keds of sheep and chamois and the temporarily winged keds of goats, deer and antelopes are close relatives, as shown especially by the similarity of the frons and antennae, so that they clearly belong to one subfamily. Yet in many

respects there is a rather wide gap between the two groups, mainly owing to the presence or absence of wings, so that it seems at least convenient to place them in distinct tribes.

6*a*. **Tribe Lipoptenini.** Wings fully developed and functional in the newly-emerged adult (volant), with greatly reduced venation, breaking off beyond the hinge after the ked reaches the breeding host. Halteres present. Thorax with some of the dorsal sutures retained and with a distinct protergum. Three genera in the Old and the New World: *Neolipoptena* (1 species), *Lipoptena* (18 species; with subgenus *Lipoptenella*), and *Echestypus* (3 species).

6*b*. **Tribe Melophagini.** Wings and halteres completely aborted the wings represented by minute rods. Most of the dorsal sutures of the thorax lacking, the protergum fused with the prescutum; but the scuto-scutellar suture retained. One genus, autochthonous in the Old World: *Melophagus* (2 species; with subgenus *Dorcadophagus*).

The foregoing arrangement in six subfamilies is based at present entirely on the external structure. In view of the general uniformity of the family both in external characters and in behavior, it seems improbable that the internal anatomy will add important characters on the subfamily level. It should be recognized, nevertheless, that this assumption is based on imperfect data. The internal anatomy is known in sufficient detail only for the sheep-ked, *Melophagus ovinus,* the most specialized member of the family, and very superficially for a few other genera, particularly *Hippobosca* and *Ornithomyia*. A general comparative study of the internal organs of the Hippoboscidae as a whole is urgently needed. It would be especially important to know whether or not the relatively primitive Ornithoicinae (*Ornithoica*) depart in this respect from the other louse-flies.

Key to Subfamilies

1. Tip of claw divided (claw apparently trifid). Antennae each protruding from its own pit, separated by a broad or narrow frontal carina. Anterior margin of prescutum deeply curved inward, with prominent humeral callosities. On birds ..... Ornithomyiinae

   Tip of claw simple (claw apparently bifid). Anterior margin of prescutum not or very slightly curved inward, the humeral callosities short and broadly rounded 2

2. Both antennae protruding laterally from a single facial pit, not separated in the middle by a frontal carina. Basisternum of prosternum undivided. On birds ..... Ornithoicinae
   Antennae each in its own pit, separated by a broad frontal carina, which is more or less fused with the lunula. On mammals (except for one species on ostrich) 3
3. Antennae large, extending beyond the pits. Basisternum of prosternum undivided. Anterior margin of frons forming two divergent lobes. On lemurs ..... Alloboscinae
   Antennae small, not or scarcely protruding from the pits 4
4. Basisternum of prosternum divided into two lobes. Median dorsal sclerites of abdomen present or absent. Anterior margin of frons even, not forming two lobes. On Artiodactyla ..... Melophaginae
   Basisternum of prosternum undivided. Median dorsal sclerites of abdomen lacking. Anterior margin of frons forming two divergent lobes 5
5. Protergum well developed in front of the prescutum. Humeral callosities broadly rounded, not projecting. On Carnivora, Perissodactyla, Artiodactyla and ostrich ..... Hippoboscinae
   Protergum not visible dorsally in front of the prescutum. Humeral callosities slightly projecting forward. On marsupials ..... Ortholfersiinae

Artificial Key to Hippoboscid Genera of the World

The purpose of the following key is to place any hippoboscid fly quickly and correctly in one of the genera I now recognize as valid. It is not intended to show relationships, these being given in a previous section on the subfamily characters.

1. Wings absent or much reduced in size and functionless 2
   Wings broad, of normal shape, used for flight 9
2. Entirely without wings and without halteres. Apical tooth of claw simple (entire claw seemingly bidentate). Ocelli absent. On mammals ..... *Melophagus*
   Wings either very short, or very narrow, or reduced to basal stumps. Halteres present 3
3. Apical tooth of claw simple (entire claw seemingly bidentate). Frons forming a single broad sclerite above and between the antennae. On mammals 4
   Apical tooth of claw bifid (entire claw seemingly tridentate). On birds 7

4. Wings very short, but with several veins and complete cells; anal vein well developed and apparently closing an anal cell. Ocelli absent. On lemurs ..... *Allobosca*

   Wings reduced to basal stumps (broken remnants of the more complete wings of newly-emerged flies), without closed cells. On ungulates 5

5. Ocelli absent. Basal sternite of abdomen crescent-shaped, with concave hind margin. Palpi short or vestigial ..... *Echestypus*

   Ocelli present. Palpi always present, though sometimes short 6

6. Basal sternite of abdomen elliptical, with broadly rounded (convex) hind margin. Fore coxa with a dorsal retrograde spur ..... *Neolipoptena*

   Basal sternite of abdomen crescent-shaped, with deeply emarginate (concave) hind margin. Fore coxa without dorsal retrograde spur ..... *Lipoptena*

7. Wings very short, about as broad as long, rounded at apex, scarcely extending beyond the scutellum. Eyes short. Ocelli absent ..... *Myiophthiria*

   Wings at least as long as the abdomen, drawn out into a point. Eyes long 8

8. Wings rarely over three times as long as broad, the basal portion always much wider than the abruptly narrowed apical portion. Ocelli absent ..... *Crataerina*

   Wings narrow throughout, nearly ten times as long as broad, very gradually and slightly widened basally. Ocelli present or vestigial ..... *Stenepteryx*

9. Apical tooth of claw simple (entire claw seemingly bidentate) 10

   Apical tooth of claw deeply bifid (entire claw seemingly tridentate). On birds 16

10. Wing with a closed anal cell and three cross-veins; apical portion of third longitudinal vein running close to the costa beyond 2nd longitudinal. Frons consisting mainly of the upper lunula, not extended downward between the antennae. Ocelli present. Anterior margin of prescutum seen from above nearly straight, leaving the sides of the head free. On birds ..... *Ornithoica*

    Wing without closed anal cell and with only one or two cross-veins. Frons a single broad sclerite between and above the antennae. On mammals or ostrich 11

11. Wing with only three distinct veins behind the costa and one long, oblique cross-vein; (wings eventually breaking off near the base). On ungulates 12
    Wing with five or six distinct longitudinal veins and two cross-veins; (wings retained throughout life). Ocelli absent 14
12. Ocelli absent. Basal sternite of abdomen crescent-shaped, with deeply emarginate (concave) hind margin. Palpi short or vestigial ..... *Echestypus*
    Ocelli present. Palpi always present, though sometimes short 13
13. Basal sternite of abdomen ellipical, with broadly rounded (convex) hind margin. Fore coxa with a dorsal retrograde spur ..... *Neolipoptena*
    Basal sternite of abdomen crescent-shaped, with deeply emarginate (concave) hind margin. Fore coxa without dorsal retrograde spur ..... *Lipoptena*
14. Anterior margin of prescutum seen from above convexly rounded, without protruding humeral callosities, leaving the sides of the head completely free. Occipital margin broadly rounded. Wing with six longitudinal veins behind the costa; membrane bare, with many fine wrinkles. Not on wallabies ..... *Hippobosca*
    Anterior margin of prescutum seen from above with a slight inward curve, the humeral callosities somewhat protruding along the sides of the head. Occipital margin truncate, nearly straight. Wing membrane as a rule extensively covered with microtrichia, not wrinkled. On wallabies. 15
15. Wing with six longitudinal veins behind the costa ..... *Ortholfersia*
    Wing with five longitudinal veins behind the costa ..... *Austrolfersia*
16. Wing with a closed anal cell and three cross-veins 17
    Wing with an open anal cell and only one or two cross-veins. Wing membrane partly covered with microtrichia 22
17. Second longitudinal vein running close to the costa, the two veins partly fused beyond the apex of the first longitudinal; anterior basal cross-vein placed about midway between the anterior cross-vein and the anal cross-vein, the second basal cell much shorter than the first; wing membrane bare. Ocelli present. Antennal appendage small, narrow ..... *Ornitheza*

Second longitudinal vein running over its entire length some distance from the costa, in which it ends at a distinct angle 18

18. Ocelli distinct. Anterior basal cross-vein placed closer to the anterior cross-vein than to the anal cross-vein, the two basal cells almost the same length 19

Ocelli absent or vestigial 21

19. Antennal appendage small, narrow, without outer rim, directed outward and downward. Wing membrane partly covered with microtrichia ..... *Ornithomyia*

Antennal appendage broad and long, leaf-like, directed forward. Wing membrane bare or with very few microtrichia 20

20. Antennal appendage with convexly curved inner margin, narrowed apically to a blunt or sharp point, at most one-half the height of the head ..... *Ornithoctona*

Antennal appendage with nearly straight inner margin, with a very broad, rounded apex, about two-thirds of the height of the head ..... *Ornithoctona* subgenus *Ornithopertha*

21. Anterior basal cross-vein placed about midway between the anterior cross-vein and the anal cross-vein, the second basal cell much shorter than the first. Antennal appendage broad and long, leaf-like. Pleurotergal process on each side of the metathorax prominent, anvil-shaped. Wing membrane without microtrichia ..... *Stilbometopa*

Anterior basal cross-vein placed closer to the anterior cross-vein than to the anal cross-vein, the two basal cells almost the same length. Antennal appendage small, narrow. No prominent, anvil-shaped pleurotergal processes on the metathorax. Wing membrane partly covered with microtrichia ..... *Ornithomyia* subgenus *Pseudornithomyia*

22. Wing with only one (anterior) cross-vein; second basal and second posterior cells also combined 23

Wing with two cross-veins; second basal cell at least partly closed 24

23. Scutellum with straight hind margin, the angular sides bearing several small, finger-shaped processes. Pleurotergal processes behind the scutellum low, scarcely developed. Ocelli absent ..... *Pseudolynchia*

Scutellum with convex hind margin, the rounded sides without finger-shaped processes. A prominent conical pleurotergal

process on each side behind the scutellum. Ocelli small, vestigial or absent ..... *Microlynchia*

24. Interocular face about evenly divided by the ptilinal suture: the upper part is a long postvertex, sometimes with a curved transverse depression; the lower part (frons) consists of the lunula and interantennal area fused into one broad sclerite, briefly emarginate at apex. Ocelli absent ... *Olfersia*

Interocular face shaped as usual: the relatively short postvertex separated from the frons by a long, soft mediovertex; lunula partly or completely divided by a suture from the much narrowed interantennal area, which ends in two slender apical arms. Ocelli usually absent, exceptionally present or vestigial ..... *Lynchia*

Geographical Distribution

I mentioned before (Part I, p. 121) that the American bird-flies are essentially tropical insects; but this is true of all hippoboscids the world over. As shown below, this peculiarity dominates their present-day geographical distribution.

Natural Means of Dispersal. The majority of louse-flies of both birds and mammals larviposit normally away from the host (Part I, pp. 185–195), in which case the emerging flies must find a suitable host by their own means. The two species of *Melophagus*, which glue the puparium to the hairs, are exceptional. Although the deälated females of the other Melophaginae larviposit likewise in the host's pelt, their puparia do not stick to the hairs, but drop off as a rule before emergence. Some bird-flies larviposit in nests or rookeries, where the proper host may usually be reached by running, without much trouble or hazard. This is the only method available to the subapterous bird-flies, which, moreover, are almost restricted to birds nesting in colonies used at regular intervals, where the flies may await the hosts' return or wander from deserted to occupied nests. However, the majority of fully-winged flies of mammals (Hippoboscinae and Ortholfersiinae) and of birds (Ornithoicinae and most Ornithomyiinae) must reach a proper breeding host by random flights a few hours or days after emerging and within a rather short distance from the spot of emergence (Part I, pp. 219–222).

Active dispersal to new territory is therefore very difficult for all louse-flies and their spatial distribution must depend primarily on passive transport after reaching a host. The present distribution and future extension of the range of every species of fly result

almost entirely from passive transport by effective breeding hosts. Some of the types of birds commonly parasitized by flies, such as marine swimmers, waders and diurnal and nocturnal birds of prey, often stray considerable distances beyond their normal territory, which no doubt explains the cosmopolitan distribution of some of the less specific bird-flies (*Lynchia nigra, L. albipennis,* and *Ornithoica confluenta*). Frigate birds (Fregatidae) are strictly speaking tropical sea-birds, but occur sometimes accidentally in temperate areas. There are records of such occurrences from eastern Canada, Germany, France and Scotland, and two of these strays carried *Olfersia spinifera* (in France, Oct. 1852: Courtiller, 1853; in Scotland, July 9, 1953: Stephen, 1953). Temporary association of a fly with an unsuitable host is a most improbable means of invading new territory, as it involves the fly's transferring to another host suitable for breeding in the new area.

Most genera and species of vertebrates occupy nowadays definite areas, often of relatively small extent, and one may expect on the whole a similar localisation for the hippoboscids. Many birds tend to spread over a wider territory than most mammals, because they are mobile and indulge in seasonal migrations which usually carry them far from the nesting sites. As a result, bird-flies are often more widely distributed than mammal-flies. In general also, flies with restricted host-specificity occupy smaller territories than those that breed on a variety of unrelated hosts. These and other points will be brought out in the following discussion.

Artificial Dispersal by Man. It was shown at some length (Part I, pp. 294–313) that the original ranges and wild hosts of most of the louse-flies of domesticated animals have been so thoroughly altered by Man, that they are now difficult to define. Except for *Hippobosca longipennis* (of Carnivora), *H. rufipes* (of antelopes), and *Pseudolynchia canariensis* (of Columbidae), these flies will be disregarded in the present discussion. Nevertheless, it is of some interest that all known louse-flies of domesticated animals originated in the Old World, an obvious corollary of the Old World origin of the domesticated hosts.

Dispersal by Man is not necessarily limited to the further diffusion of domesticated hosts. Louse-flies are spread sometimes to new territory in attempts to acclimatize wild hosts. Following the importation of infested deer, the European deer-ked, *Lipoptena cervi,* became permanently established on native deer (*Odocoileus virginianus*) in the northeastern United States within the past 50 to 75 years. I regard the occurrence of the American

Ornithoica vicina in the Hawaiian Islands as due to the agency of Man (1941*b*, p. 289), and I explain on the same basis the presence of the Holarctic *Ornithomyia fringillina* in New Zealand and Australia. In these areas foreign birds have been introduced on a larger scale than anywhere else (see G. R. Williams, 1953, *The Ibis*, **95**, pp. 676–692).

Until the advent of aviation some 50 years ago, obligate ectoparasites could be imported by Man only by transport on live hosts. The extraordinary speed with which aircraft now connects distant parts of the world, has resulted in a novel and most effective method of bringing a variety of insects to new areas. Hippoboscidae are occasionally intercepted on planes arriving from foreign countries, in spite of the specialized habitat and relative scarcity of these flies.[4] I recorded (1951) *Pseudolynchia canariensis, Hippobosca variegata* and *Olfersia aenescens* being found under such circumstances in North America and the Pacific area and called attention to earlier records by Whitfield (1939, p. 51) of *Hippobosca variegata* (= *maculata*) and *H. camelina* being taken on aircraft landing at Khartoum. Hughes (1949, p. 32) had previously listed the following hippoboscids among the insects found from July 1, 1944, to June 30, 1945, on planes arriving from abroad at eastern United States airports (Brownsville, Fort Worth, New Orleans and Miami) and in Puerto Rico: *Lynchia* sp. (1 dead); *Ornithoica* sp. (1 dead); *Pseudolynchia canariensis* (2 dead and 2 alive); and 1 dead undetermined fly. Thompson (1952*a*) observed a *Hippobosca variegata* alive on the window in a plane shortly after leaving El Adem, Anglo-Egyptian Sudan, September 22, 1950. Dr. J. H. Hughes informs me (*in litt.*, 1953) that the collection of the Division of Foreign Quarantine of the U. S. Public Health Service contains a specimen of *Olfersia fossulata* taken February 19, 1949, on a plane arriving at New Orleans from Balboa, Panama. I have also seen at the U. S. National Museum a female *Hippobosca camelina* found dead on a plane landing at New York, June 2, 1947, from Buenos Aires, after stopping *en route* in Puerto Rico. As *H. camelina* is a strictly Old World fly, it could have

[4] These occurrences are perhaps less surprising in view of the large numbers of arthropods that now travel continuously on aircraft the world over. Hughes (1949) reports that during the 10-year period 1937–1947, of 80,716 planes inspected at United States airports upon arrival from abroad 28,752, or 35.6 per cent, carried arthropods. Of 106,106 arthropods intercepted, 16,846 were alive.

entered the plane only on a previous flight to Africa. The possibility that species of Hippoboscidae may be temporarily imported or even become permanently established after escaping from aircraft, will have to be considered in the future in appraising unusual occurrences.

General Distribution. Three of the six subfamilies, the Ornithoicinae, Ornithomyiinae and Melophaginae, are cosmopolitan, the others being restricted to the Old World. Among the latter, the Hippoboscinae are at present widely distributed on domesticated animals in Europe, Africa, Madagascar, southern Asia (as far north as Peking), Indonesia, New Caledonia, and recently Australia; but they are known on wild hosts in Africa and Arabia only, which area was probably their original, natural habitat before Man interfered. The Alloboscinae are restricted to Madagascar and the Ortholfersiinae to Australia and Tasmania.

Of the 20 genera here recognized as valid, 9 occur on original wild hosts in both the Western and Eastern Hemispheres: *Ornithoica, Ornithomyia, Crataerina, Myiophthiria, Ornithoctona, Lynchia, Pseudolynchia, Olfersia,* and *Lipoptena;* 8 are precinctive in the Old World: *Ornitheza, Stenepteryx, Echestypus, Melophagus, Hippobosca, Allobosca, Ortholfersia,* and *Austrolfersia;* and 3 are peculiar to the New World: *Stilbometopa, Microlynchia,* and *Neolipoptena.* The New World is therefore somewhat poorer in generic types than the Old, besides lacking peculiar subfamilies. The relative wealth in hippoboscids of the Old World is even more striking on the specific level, as it has 87 to 89 native species, as compared with 43 in the New World, only 8 of these occurring in both areas.

Factors Regulating Specific Distribution. The spatial distribution of integral ectoparasites, such as the Hippoboscidae, is irrevocably tied up with the presence or absence of appropriate hosts. The discussion of the host-parasite relation in Part I stressed throughout that, whatever happens to individual flies, the only normal or true hosts from the point of view of the species are those on which it can maintain itself through successive generations, or what I called the breeding hosts (Part I, pp. 218–219). I have also shown that the degree of specificity varies within the family from flies restricted to one or a few species in one genus of hosts to such with multiple suitable hosts sometimes belonging to several unrelated orders. Host specificity is more pronounced for the mammal-flies than for the bird-flies and it is, on the whole, ecological rather than taxonomic (Part I, pp. 332–336). These and some other

minor peculiarities of hippoboscid specificity have an important bearing on the past and present-day geographical distribution of the flies.

While a given species of hippoboscid obviously cannot occur in the absence of a suitable host, the presence of such a host does not necessarily imply that of its specific louse-fly also. The distributions of host and parasite do not always coincide, as is sometimes assumed or even claimed. Macroclimatic and possibly other factors outside the host are by no means negligible (Part I, pp. 120–124). Indeed climate, not the lack of appropriate breeding hosts, usually checks the northward extension of louse-flies. This is well illustrated by *Lipoptena mazamae,* a common and widespread parasite of Cervidae in tropical America, where it flourishes on several species and races of two genera (*Mazama* and *Odocoileus*). It enters temperate North America in the southeastern United States, extending as far north as South Carolina along the Atlantic coast (to about 33° 30′ N.), where it occurs on Virginia deer (*Odocoileus virginianus*). North of this latitude, however, and throughout the northeastern United States and eastern Canada lies a vast area where Virginia deer harbor no autochthonous deer-keds.[5] In the passage cited above I have presented further evidence of the influence of the macroclimate on louse-fly distribution.

Specific Types of Distribution. In view of the foregoing considerations, it is not surprising that the distribution of the hippoboscids does not fit well in the customary frame of the Earth's zoogeographical realms, regions, subregions and provinces. It seems more profitable to analyze the several types of distribution observed among these insects. As explained before, most of the flies that owe their present distribution at least in part to the agency of Man will not be included in the following discussion. *Hippobosca longipennis, H. rufipes, Pseudolynchia canariensis,* and *Lipoptena cervi* are considered only in so far as they have been found on autochthonous wild breeding hosts.

1. Not more than 7 species are nearly ubiquitous or cosmopolitan, having spread by natural means to both the Western and the Eastern Hemispheres. Three species of *Olfersia* live on oceanic birds, the genera and sometimes even the species of their hosts oc-

[5] The present occurrence of the European deer-ked, *L. cervi,* on Virginia deer in a few localities in New Hampshire, Massachusetts, New York and Pennsylvania does not detract from this statement, as this parasite is a recent introduction by Man.

curring over all oceans: *O. spinifera* of frigate birds; *O. aenescens* of various swimmers, but chiefly boobies and tropic-birds; and *O. fossulata* mainly of guanays, pelicans and boobies. Three other flies parasitize continental birds: *Ornithoica confluenta* and *Lynchia albipennis* of waders (Ciconiiformes), and *Lynchia nigra* of birds of prey (Falconiformes and Strigiformes). As shown by the details of their distribution, the foregoing six flies are tropicopolitan rather than cosmopolitan; they are most common in the Tropical Zone, beyond which they extend only over limited areas or as sporadic strays with the accidental wanderings of the hosts. The seventh species, *Olfersia fumipennis,* a specific parasite of the osprey (*Pandion*), is more widespread than the others and in fact the most nearly cosmopolitan hippoboscid. It is known in the Old World from Finland (close to 63° N.) to Indonesia and in the New World, from British Columbia (close to 51° N.) to Rio de Janeiro, but will probably be found wherever ospreys nest, near the sea as well as far inland.

2. The distribution of the one strictly Holarctic hippoboscid, *Ornithomyia fringillina,* will be considered in detail in the taxonomic section. It is definitely known in Europe and northern Asia from the Shetlands, Iceland, northern Scandinavia, and Finland (close to 70° N.) to northern Italy, northern China and Japan; but the data for its distribution in Asia are inadequate. There are, however, no reliable records from Africa, Asia Minor, southern Asia, and Indonesia. Flies indistinguishable from *fringillina* occur in Australia and New Zealand; but I regard this as due to recent importations by Man of infested European birds. In America it extends from Alaska and the Yukon in the west (68° N.) and Labrador in the east (53° 20′ N.) to Mexico City; but the 5 and only records from south of the Rio Grande were possibly stray flies brought in by migrant hosts from farther north. As noted before (1950, p. 113; Part I, pp. 121–122), *O. fringillina* is the hippoboscid which has spread farthest north.[6] Of the 7 arctic or subarctic New World records, 2 are from typically boreal birds, the hawk owl (*Surnia ulula*) and the pipit (*Anthus spinoletta*), which occur also in the northern Palearctic Region. All evidence points to *fringillina* being autochthonous in North America. It is the only

[6] The statement in Part I (p. 124) that the sheep-ked is the hippoboscid which reaches farthest north is erroneous, as it does not extend nearly as far as *O. fringillina;* moreover, its present northern distribution is artificial and due to importation by Man.

louse-fly for which direct arrival on hosts crossing Bering Strait, after the last Glacial Period, may be postulated.

3. The Palearctic Region has some 10 precinctive species. Six of these occur on mammals: *Melophagus rupricaprinus* and *Lipoptena couturieri* of chamois; *L. cervi* of roebuck and red deer; *L. japonica* of dwarf serow; and the poorly known Siberian *Lipoptena moschi* of musk-deer and *L. antilopes* of zeren. Four bird-flies are probably also restricted to this area, although it is as yet unclear whether all are specifically distinct from tropical forms: *Ornithomyia biloba* and *Stenepteryx hirundinis* of swallows; and *Crataerina pallida* and *C. propinqua* of swifts.

4. There appear to be only 5 strictly Nearctic flies, 2 on mammals (*Lipoptena depressa* and *Neolipoptena ferrisi* on deer) and 3 on birds (*Lynchia hirsuta* and *Stilbometopa impressa* on quail and related game birds, and *Myiophthiria fimbriata* on swifts).

No species of hippoboscid restricted to the temperate zone of the Southern Hemisphere (south of the Tropic of Capricorn) is known to occur at the same time in the Old and the New World.

5. Only one fly, *Ornithomyia parva,* is definitely peculiar to the temperate part of South America (at least to 40° 20′ S.). It is mainly a parasite of various Passeriformes, although breeding also regularly on two flightless rails, and appears to be the southern representative species of the Holarctic *O. fringillina,* which has similar host preferences. *O. parva* is of more than passing interest as the only hippoboscid of the few endemic land birds of the Tristan da Cunha Group, which lies in mid-Atlantic and actually closer to Africa than to America. *Lynchia penelopes* Weyenbergh (1881), described from Argentina, is at present unrecognized and must be omitted from this discussion.

6. The hippoboscid fauna of the temperate southern half of Australia and Tasmania is inadequately known, so that the following remarks are provisional. I have recognized some 16 native species in several collections seen in recent years; but about half of them are widely distributed in the Paleotropics or extend at least to northern Queensland, New Guinea or Indonesia. The 4 or 5 species of wallaby-flies (*Ortholfersia* and *Austrolfersia*) are, so far as known, restricted to temperate Australia and Tasmania. Among the bird flies, *Ornithomyia fuscipennis* Bigot (= *O. perfuga* Speiser), 2 presumably undescribed species of *Ornithomyia* of swallows, and one species of *Lynchia* are possibly also precinctive.

New Zealand harbors at present only 3 hippoboscids, all widespread species and, I suspect, introduced by Man during the past two centuries.

7. The Paleotropical Realm is richer in hippoboscids than any other similar main division of the earth, even though it is as yet far from sufficiently explored. Of the 68 or more species known from that area, 7 are cosmopolitan, 12 occur also in the Palearctic Region or extend into the temperate part of Australia, and the remaining 49 are tropical endemics. The western and eastern Paleotropics, as divided by the Indian Ocean, show such sharp faunal differences, particularly in regard to mammals and birds, that they should be considered separately. Indeed, they have no tropical endemics in common. The following 18 or 19 species are restricted to the Ethiopian Region (continental Africa and southwestern Arabia): *Hippobosca fusca, H. hirsuta, H. longipennis* (on wild hosts), *H. rufipes, Lipoptena hopkinsi, L. chalcomelaena, Echestypus binoculus, E. paradoxus,* and *E. sepiaceus* of mammals; *Hippobosca struthionis, Ornithomyia fur, O. inocellata, Crataerina acutipennis, Ornithoctona laticornis, Lynchia pilosa, L. schoutedeni,* and 3 or 4 undescribed *Lynchia* on birds. The Oriental Region (from India to Formosa, the Fijis and Queensland) has 30 precinctive species as follows: *Lipoptena efovea, L. grahami, L. pauciseta, L. rusaecola,* and *L. gracilis* on mammals; *Ornithoica pusilla, O. unicolor, O. philippinensis, Ornithomyia comosa, Ornithoctona australasiae, O. plicata, O. soror, Crataerina longipennis, Myiophthiria lygaeoides, M. reduvioides, Lynchia acromialis, L. chalcolampra, L. dioxyrhina, L. longipalpis, L. nigrita, L. papuana, L. parallelifrons, L. bicorna, L. samoana, L. suvaensis, L. sarta, L. trita, L. tuberculata, L. vagans,* and *L. simplex* on birds. The eastern section thus proves to be richer in bird-flies and poorer in mammal-flies than the western section.

In the foregoing paragraph the African continent has been treated as a unit. Although there is a slight decrease in the number of species both north of the Tropic of Cancer and south of the Tropic of Capricorn, the hippoboscid faunae of these more temperate or subtropical areas differ little from that of the strictly tropical part and it is difficult to draw the line between them.

Few hippoboscids are known from Madagascar, the Mascarenes and the neighboring islands in the western Indian Ocean, no doubt owing to insufficient collecting. Neglecting the introduced *Hippobosca variegata* of cattle and *Pseudolynchia canariensis* of domestic pigeon, only 6 or 7 species have been recorded. One is a precinctive mammal-fly, *Allobosca crassipes* of lemurs. The others are bird-flies widespread elsewhere: *Lynchia albipennis* and *Ornithoica confluenta* are cosmopolitan; *Pseudolynchia rufipes* (originally described from Reunion) occurs throughout Africa,

the Oriental Region as far as the Philippines, and occasionally in southern Europe; *Ornithoctona laticornis* (= *Ornithoctona idonea* Falcoz, described from Madagascar) is Ethiopian; and *O. plicata* is common throughout the Oriental-Indonesian Region as far as Queensland and Samoa. Falcoz (1930, p. 47) records *Lynchia dioxyrhina,* originally described from New Guinea, from Great Comoro I., but this will need confirmation.[7] The Hippoboscidae contribute nothing of importance to the problem of the Ethiopian or Oriental ("Gondwanian") origin of the Malagasy fauna.

The fair-sized Hawaiian Islands, in mid-Pacific over 2000 miles from California, 3000 miles from Japan and 4000 miles from Australia, have a highly peculiar fauna. It is perhaps more noteworthy for its negative than for its positive features and has been the subject of much controversy. The 8 species of Hippoboscidae throw no light on the matter. Two of them, the sheep-ked and the pigeon-fly, were introduced by Man with domestic animals. Two are cosmopolitan flies of oceanic birds: *Olfersia spinifera* and *O. aenescens. Lynchia nigra,* a cosmopolitan parasite of birds of prey, occurs on the native, endemic owl, *Asio flammeus sandwichensis. Ornithoica pusilla,* common on a variety of hosts in Indonesia, Australia and the Pacific Islands, has been taken in Hawaii on the endemic owl, on a parrot introduced from Australia (*Melopsittacus undulatus*) and on 2 honey creepers (Drepanidae), a family of birds precinctive of the Islands. *Ornithoica vicina,* of the New World, taken only on introduced pheasant, white-eye (*Zosterops*), and English sparrow, is clearly a recent importation by Man. The fly which Speiser (1902*c*, p. 89) reported from Molokai as *Ornithomyia varipes* and which I doubtfully referred (1941*b*, p. 260) to *Ornitheza metallica,* was actually *Ornithoctona fusciventris,* a common New World species; it may also be a recent human importation. This medley clearly consists of accidental waifs which, in so far as they are truly autochthonous, reached the Islands from time to time on stray birds.

8. Some of the common and therefore most characteristic hippoboscids of the Paleotropical Realm, are not strictly precinctive

[7] *Ornithomyia variegata* Bigot, described from New Zealand, is, to judge from the type, a synonym of *O. fringillina.* Speiser (1908*a*, p. 178; 1908*b*, p. 204; 1908*c*, p. 308) recorded *O. variegata* from Madagascar, but without further data. *Olfersia testacea* Macquart, described from Reunion, is the pigeon-fly, *Pseudolynchia canariensis.*

but extend either normally or casually to the temperate zones, especially in the southern Palearctic Region. The following 7 bird-flies belong in this group: *Ornithoica turdi, Ornithomyia avicularia, Crataerina melbae, C. obtusipennis, Pseudolynchia canariensis* (on wild hosts), *P. rufipes,* and *Ornitheza metallica.* The most interesting is *Ornithomyia avicularia,* which has spread farther north than any and is a normal element of the Palearctic fauna. In Europe it does not occur as far north as *O. fringillina,* stopping at the Shetlands, southern Scandinavia and southern Finland, and is much scarcer in these northern areas than *fringillina.* It seems to be widespread in the Old World tropics, as I have seen it, in Africa, from Uganda, Tanganyika Territory, Ruanda and the Belgian Congo, and, in the Oriental area, from Ceylon, Tonkin, Formosa, the Philippines, Australia, Tasmania, New Caledonia and New Zealand (? introduced here). The unusually wide range of this fly is no doubt due to its low grade of host specificity (Part I, p. 327). For instance, in the British Isles alone Thompson (1954*a,* pp. 31–33) reports it from 46 species of Passeriformes, Piciformes, Cuculiformes, Strigiformes, Falconiformes, Ciconiiformes, Gruiformes, Charadriiformes, Columbiformes and Galliformes, an impressive list, even though it includes casual in addition to effective breeding hosts.

9. The Neotropical Realm is much poorer in hippoboscids than the Paleotropics, even though its fauna is more thoroughly explored, so that the relative poverty will only be enhanced by future research. The number of strictly precinctive species is further reduced by the greater tendency of the flies to move into temperate and subtropical areas. Out of a total of 36 species known to occur in the Neotropics, 7 are cosmopolitan and 15 extend north of the Tropic of Cancer or south of the Tropic of Capricorn. This leaves only 14 species restricted to the Neotropical Realm, or less than half of the total: one mammal-fly, *Lipoptena guimarãesi;* and 14 bird-flies, *Ornithomyia ambigua, O. hoffmannae, Ornithoctona oxycera, O. orizabae, O. nitens, Stilbometopa legtersi, S. ramphastonis, Myiophthiria neotropica, Lynchia latifacies, L. plaumanni, Microlynchia crypturelli, M. furtiva,* and *Olfersia coriacea.*

The Antilles, excluding Trinidad, Tobago and the islands off the Venezuelan coast, have only a depauperate tropical American hippoboscid fauna, without distinctive features. There are no mammal-flies, owing to the lack not only of Cervidae (the only autochthonous mammalian fly hosts in the New World) but of all Artiodactyla. The 15 Antillean bird-flies comprise all 7 known

cosmopolitan species, *Ornithoica confluenta, Lynchia nigra, L. albipennis, Olfersia fumipennis, O. spinifera, O. aenescens,* and *O. fossulata;* 7 flies widespread in the New World, *Ornithoica vicina, Ornithoctona erythrocephala, O. fusciventris, Stilbometopa ramphastonis, Pseudolynchia brunnea, Microlynchia pusilla,* and *Olfersia sordida;* and the apparently precinctive *Stilbometopa fulvifrons* (except for one stray New Jersey record). The last-named belongs, however, to a genus as yet imperfectly known; it may eventually be found on the South American continent also. That the Hippoboscidae of the Antilles are a commonplace lot is to be expected, as the area is the bridge commonly used by many migratory birds travelling back and forth between North and South America.

10. As mentioned in the discussion of the Neotropical flies, the Nearctic Region shares many of its hippoboscids (14 species in all) with Central and South America. Only one of these is a mammal-fly, *Lipoptena mazamae,* briefly considered in a previous discussion of the factors regulating distribution. The remaining 13 are bird-flies: *Ornithoica vicina, Ornithoctona erythrocephala, O. fusciventris, Stilbometopa fulvifrons, S. podopostyla, Lynchia americana, L. angustifrons, L. holoptera, L. wolcotti, Pseudolynchia brunnea, Microlynchia pusilla, Olfersia sordida,* and *O. bisulcata.* To these must be added 5 of the cosmopolitan flies listed under 1 (except *Olfersia aenescens* and *O. fossulata*) and the Holarctic *Ornithomyia fringillina.*

11. Apart from the precinctive *Ornithomyia parva* discussed before and the cosmopolitan *Lynchia nigra* and *L. albipennis,* the 9 hippoboscids recognized at present in the temperate part of South America (south of the Tropic of Capricorn) are all species that invade the area from the Neotropics. Most of these occur only in the northern, more subtropical sections, but a few do reach northern Patagonia. Unfortunately information on this vast area is scant and some of it does not seem fully trustworthy. At present there are reliable records for one mammal-fly, *Lipoptena mazamae* (to 27° 30′ S.) and 8 bird-flies: *Ornithoica vicina* (to Puerto Montt, Chile, 41° 30′ S., the southmost for any New World hippoboscid), *Stilbometopa legtersi* (to about 25° S.), *Crataerina seguyi* (to about 32° 30′ S.), *Ornithoctona erythrocephala* (to about 33° S.), *O. fusciventris* (to about 28° S.), *Lynchia americana* (to about 28° 30′ S.), *Pseudolynchia brunnea* (to about 38° S.), and *Microlynchia pusilla* (to about 25° 20′ S.). Only two of these (*C. seguyi* and *S. legtersi*) are additional to the list of flies entering the Nearctic Region from the tropics.

Conclusions. Some fifty years ago Speiser (1908*c*) published an essay on the geographical distribution of the Hippoboscidae (and other ectoparasitic pupipara), intended to correlate it with their phylogeny. This creditable review of the contemporary knowledge of the flies contained some valuable suggestions, but did not throw much light on the phylogeny of the family. The foregoing review shows that the distributional pattern of the Recent Hippoboscidae is extremely complex, controlled as it is at present by the interaction of different types of host specificity, ecological peculiarities of the hosts (particularly their seasonal migrations) and macroclimatic factors. All three influences were active also throughout the geological past with continually varying and mostly unknown results, so that it is difficult to see how the present-day distribution of the flies could teach much about their past history.

It is most unlikely that the fossil record will ever furnish adequate pertinent data, particularly owing to the difficulty of determining the true host relations of extinct flies. When the fossil fits in a Recent genus, as in the case of *Lynchia rottensis,* it may be safe enough to decide whether it was a bird-fly or a mammal-fly;[8] but to go beyond this is blind guesswork. If, however, some fossil fly were discovered so aberrant that it could not be placed in any Recent genus or subfamily, it would be utterly impossible to settle the type of vertebrate on which it lived.

Another consideration should warn us to be most cautious in drawing conclusions from the present-day distribution of the louse-flies. It will be generally agreed, I suppose, that no appreciable addition has been made to the sum total of living animal genera and species since the start of the Holocene or Recent Era, but that on the contrary there has been a steady loss. In some groups of animals this loss possibly does not affect appreciably the validity of conclusions based on what remains available for study to-day. In the case of the Hippoboscidae, however, it is of unusual importance, first because of the very limited number of Recent genera (20) and species (fewer than 150 known at present), and second because of the fairly strict host specificity of most flies. Ever since the dawn of Man the destruction of the vertebrates has been carried on with increasing vigor and it has particularly gained momentum during the past 500 years. The list of the known extinct Recent mammals and birds is now extensive and some of them

[8] The Recent *Hippobosca struthionis,* a bird-fly of a genus otherwise restricted to mammals, shows that even this type of evidence is not always conclusive.

were no doubt potential hosts of louse-flies. As a result, it is no longer possible to determine what the original Recent fauna of louse-flies and their hosts may have been at the close of the Pleistocene in the Mediterranean countries, western Europe, much of the United States and South Africa. Under the circumstances it seems futile to attempt to trace from the present-day distribution the possible routes of migration of the living Hippoboscidae.

The remarks to follow will be more in the nature of a summary than of far-reaching conclusions. The evidence is, I believe, overwhelming that the Hippoboscidae are essentially tropical insects. In spite of the well-sheltered habitat in pelt or plumage, few of them venture north and south of the Tropics and then mostly by accident. Very few have been able to gain a permanent foothold in temperate climes. Only one (*Ornithomyia fringillina*) succeeds in living during the summer under subarctic or arctic conditions. Out of a total of some 117 to 120 species from wild hosts, 92 occur in the intertropical area, 16 being mammal-flies and 76 bird-flies. On the other hand, only 52 or 53 species have been found north of the Tropic of Cancer or south of the Tropic of Capricorn, 14 being mammal-flies and 39 bird-flies. Moreover, the extratropical flies are a disparate group (Part I, p. 234): several are accidental stragglers from the tropics, known from half a dozen or fewer records in temperate regions, so that strictly speaking they are not part of the fauna; some 20 are typical tropical flies which normally extend their ranges to temperate areas, particularly the subtropical parts; the strictly extratropical flies, namely the 25 species mentioned in sections 2 to 6 above (12 mammal-flies and 13 bird-flies), are the minority. Needless to say, some border-cases must be placed arbitrarily, but they do not detract from the general validity of the grouping. The predilection of the flies for warm climates is further shown by the steady decrease in the number of species from north to south within the Holarctic Realm, as was brought out in Part I (pp. 235–236). I also pointed out that the normal northern limit for the family lies at about the 50th parallel in the New World and somewhat farther north in the Old World, and that it generally follows the annual isotherm of 30° F. (Part I, pp. 121–122). The sporadic summer records of *Ornithomyia fringillina* from north of the Arctic Circle are very few.

The detailed analysis of the specific distribution also brings out the individuality of the hippoboscid faunae of the Eastern and Western Hemispheres. Out of a total of 122 to 125 recognizable species, 76 to 90, including 5 known only from domestic hosts, are

native in the Old World (30 or 31 on mammals and 58 or 59 on birds), and 43 in the New World (4 on mammals and 39 on birds). Of these only 8 bird-flies are common to both areas, 7 being cosmopolitan and 1 Holarctic; but, although only a small fraction of the total, these widespread species show that natural exchanges of parasitic flies occur from time to time between the two continental areas by means of the more mobile avian hosts. The Holarctic *Ornithomyia fringillina* presumably reached North America from northern Asia in post-Glacial times; but the other, more cosmopolitan flies teach us nothing about the possible routes of dispersal of the Hippoboscidae during Recent or earlier geologic periods. They could easily have attained their present distribution by natural means with the present-day topography of the continents. The scarcity of mammal-flies in the New World may be explained by the relative poverty in genera and species of Recent Artiodactyla, which are the most favored hosts of the living mammal-flies (Part I, p. 286).

It must not be overlooked that the spatial distribution of animals is by no means static, as it deals with successive populations which are in a constant state of flux. This dynamism is particularly important for the Hippoboscidae and similar parasites, where fluctuating populations of parasites depend upon populations of hosts undergoing their own fluctuations. Some of the changes involved are secular or of long range and concern more the past history of the animals; although the expansion or contraction of the area covered by the breeding hosts or their relative abundance from year to year may affect even the present-day distribution of the flies. Some other aspects of the problem were presented in Part I (pp. 224–234).

In discussing the possibility of new breeding hosts being acquired (Part I, pp. 244–246), I noted the need for observations in connection with the natural spread of certain birds to new territory. Thus far the best evidence we have in the matter has to do with the importation of new hosts by Man, several examples of which I have listed. An additional case of this type has developed recently in Scotland. Following the importation of a herd of reindeer, *Rangifer tarandus,* from Norway, it was discovered that within a few weeks after their arrival (September, 1953), the animals had become heavily infested with *Lipoptena cervi,* the common native ked of Scotch deer. The case is of particular interest because keds have never been found on reindeer in its natural

arctic and subarctic habitat in northern Eurasia, nor on its North American representative, the caribou, *Rangifer tarandus caribou*.[9]

Another aspect of dynamic distribution involves the seasonal fluctuations of the flies, treated at some length in Part I (pp. 234–244). It was assumed there that these are probably of little significance in the Tropical Zone. Data were presented, however, suggesting that in the Temperate Zone the seasonal migrations of many birds may be one of the paramount factors regulating the breeding and hence the strength and variations of louse-fly populations. Unfortunately observations bearing on this topic are so few and so fragmentary that it would be premature to draw conclusions. The problem appears to be extremely complex and will be best approached by careful studies of individual species over a large territory and in relation to all their effective breeding hosts.

EVOLUTION

It was shown in Part I that nearly all peculiarities of structure and bionomics of the Hippoboscidae are modifications of homologous or analogous features found in some of the free-living higher Diptera and that they are clearly adaptive to an almost unique type of integral ectoparasitism. The appearance and further refinement of these adaptations can only be explained logically as due to the action of Natural Selection upon genetic, hereditary variations in the process of Evolution. Taxonomy is the comparative study of the hereditary differences in morphology, physiology and behavior between the species (or groups of populations with the same inheritance) and between the higher categories of species with common characteristics. As such, it is inseparable from the study of Evolution and actually provides the only factual clues as to the lines of descent above the species level.

The following critical appraisal of the peculiarities of the Hippoboscidae, thought to be of significance in major phyletic evolution, is kept as factual as possible and stresses the present limitations of our knowledge. Conflicting theoretical views are presented in sufficient detail to enable the reader to make his own choice. In discussions of evolution a certain amount of speculation is unavoidable and can do no real harm if it is clearly distinguished from observable fact. Its chief usefulness, however, should be as an in-

[9] I am indebted to Dr. D. S. Kettle for calling my attention to this occurrence, as well as for sending me some of the keds taken from reindeer in Scotland.

centive to renewed study of the morphology and natural history of the organisms.

For the convenience of discussion the term Proto-Hippoboscidae has been coined for the hypothetical group comprising the immediate ancestors of the Recent Hippoboscidae.

I. Fossil Record

Organic evolution being essentially a historic phenomenon, the most trustworthy foundations for a true phylogeny of Recent organisms are historical data furnished by the fossil remains of extinct forms. Unfortunately, for most higher insects and particularly for the Diptera, the fossil record is woefully inadequate. The Hippoboscidae are no exception. No fossil louse-fly was known until Statz (1940, p. 154; 1941, pp. 12–13 of reprint) described *Lynchia rottensis* (as *Ornithoponus rottensis*) from a fairly well-preserved specimen discovered in the Upper Oligocene shales (Aquitanian) of Rott (Siebengebirge, Rhineland, Germany). His description is as follows (translated from the German): "This well-preserved louse-fly is present in both the obverse and the reverse. It lies on the venter. The wings are spread out backward; the legs are in the normal position on both sides of the body. Length of body, 4.2 mm.; of wing, 4 mm.; greatest width of wing, 1.4 mm. Head rounded, as wide as long, brown, with a few setae. Eyes small, round, blackish. No ocelli. Thorax large, roundish, blackish-brown, sparsely hairy and with several long setae. Prothorax emarginate anteriorly, the humeral callosities somewhat prominent. Transverse suture of mesonotum distinct, rather stretched. Scutellum wide and short, rounded posteriorly. Wings well developed, extending far beyond the abdomen, narrowly rounded anteriorly. Surface of wing with microtrichia; veins dark brown. Costa straight, finely setose and apparently reaching $r4+5$ [apex of 3rd longitudinal]; subcosta long, parallel to costa, in which it ends. Radial veins all very strong: $r1$ [1st longitudinal] short, reaching costa before mid-length of wings; $r2+3$ [2nd longitudinal] straight, ending beyond mid-length; $r4+5$ [3rd longitudinal] stretched, ending in the anterior margin far from wing tip. All other veins very weak; $m1+2$ [4th longitudinal] slightly bent down beyond cross-vein *r-m* [anterior cross-vein] toward hind margin, which it does not reach. Cubital vein [5th longitudinal] evenly and slightly curved, likewise not reaching hind margin. No cubital [anal] cell. Legs sparsely setose, pale brown; tarsi somewhat darker. Femora a little thickened, with strong, dark setae. Tar-

sal segments short, the last one thick, with strong, bispinose claws. Abdomen blackish-brown, about as long as, but narrower than, thorax, pointed posteriorly. Pilosity not dense; scattered long setae posteriorly. Number of segments not clear, apparently 5 or 6 before genital opening.'' This account and the figures (1940, Pl. 22, fig. 50, drawing of wing; Pl. 27, fig. 93, photograph of fossil; 1941, pp. 12–13 of reprint, figs. 16–17, photographs of reverse and obverse of fossil) refer clearly to a *Lynchia* (= *Ornithoponus*) similar to some of the small Recent species, so that there is no reason to doubt that it was a bird-fly.[10] The preserved characters do not allow a detailed comparison with the Recent species, of which there are some 30 on a variety of hosts. Some are partial to birds of prey, others to gallinaceous game birds, waders, bustards, or rails; but only one is strictly specific of waders. It is impossible to guess the type of bird on which *L. rottensis* lived. As the species of *Lynchia* (= *Ornithoponus*) are by no means restricted to wading birds, Statz's (1940, p. 168) surmise that swamps with wading birds possibly existed at Rott during the Oligocene is not substantiated by this fossil.

Lynchia rottensis proves that the Hippoboscidae had reached their present-day maturity by mid-Tertiary and produced by then at least one of the more specialized genera of the subfamily Ornithomyiinae. The prominent humeral callosities and bifid claws of *L. rottensis* are characteristic for this subfamily while the lack of ocelli and of a closed anal cell are further specializations of certain of its members, such as *Lynchia*. It may be surmised that by mid-Tertiary probably all Recent subfamilies and genera of Hippoboscidae (and perhaps some additional ones, now extinct) were developed in their present form. This would fit in with the wealth of suitable avian and mammalian hosts known to have existed at that time. The family being by then fully mature, it must be of much greater antiquity, a conclusion which agrees with what is known in general of fossil Diptera. The order was most flourishing throughout the Tertiary, comprising up to 27 per cent of the fossil insect species known from that period, while it dropped later to about 10 per cent in the Recent insect fauna (Carpenter,

[10] In Statz's paper of 1941, fig. 16 (p. 12) shows the reverse and Fig. 17 (p. 13) the observe of the fossil (not the dorsal and ventral sides, as the captions state). Actually in fig. 17 the scutellum and the mesonotum, with the median notal and transverse mesonotal sutures, of the dorsum are very clear.

1930, p. 27). In the earlier Tertiary, particularly during the protracted Eocene, most modern families of Diptera appear to have existed, including some of the Recent Cyclorrhapha Aschiza (Syrphidae and Clythiidae [or Platypezidae]), Conopidae, and Cyclorrhapha Schizophora (Sciomyzidae). Few Eocene fossils are at present referable with certainty to the higher Cyclorrhapha or muscoids (Townsend's Oestromuscaria), from which type the Proto-Hippoboscidae were more probably derived. But, as the muscoids are represented in Oligocene and Miocene deposits by some very specialized types (such as the Glossinidae), evidently they appeared before the Eocene and probably toward the close of the Mesozoic era. In all probability primitive higher muscoid flies, of types that might have given rise to both the ancestral Proto-Hippoboscidae and Proto-Glossinidae, were already fairly abundant during Cretaceous times, if not earlier.[11]

II. Relationship with Other Recent Diptera

The fossil record being wholly inadequate for the purpose, attempts at tracing the ancestry of the Hippoboscidae will have to rely on the comparative morphology, ecology and behavior of the Recent forms. They will have to lean heavily on structural homologies, which are sometimes in dispute. Moreover, in most holometabolous orders of Insects and especially in Diptera, it is often difficult to decide which of several peculiarities shared by two groups are due either to convergence, having been acquired independently, or to true phylogenetic kinship, being then part of a

[11] The evidence for the existence of higher muscoids during the Upper Eocene consists of an adult tachinid-like fly (*Lithexorista*) from the Green River formation of Wyoming and accumulations of muscoid maggots in the White River formation of Colorado. Townsend (1942, **12**, pp. 11–19) referred these maggots to 2 Recent and 2 extinct genera, claiming that 3 of the genera were true bot-flies. More probably most, if not all, of the maggots were saprophagous on dead vertebrate bodies. This agrees better with the presumed ecology of the ancient "Lake Uinta," where the White River sediments accumulated (W. H. Bradley, 1936, *Scientific Monthly*, **43**, pp. 421–430). Townsend dated the Green River deposits as Eocene and those of the White River as older (Paleocene); but American geologists now nearly agree that both formations are Upper Eocene, the White River deposits being only slightly older than the others.

common early heritage. Fortunately these difficulties are not as insuperable in the Hippoboscidae as in some other dipterous families, due perhaps to the maturity and fundamental uniformity of the louse-flies. As I attempted to do in Part I, reliable homologies can be traced for most structures, at least in the less specialized forms. The generalized features retained by the louse-flies, and which they now share with some other flies, can usually be recognized and regarded with reasonable confidence as inherited from the same or a closely allied ancestral stock.

Pupipara an Artificial Group. Latreille made the first rational attempt to subdivide the order Diptera. Like most of his contemporaries, he was so forcibly impressed by the unusual combination of integral viviparity (pupiparity), flattened, leathery body, spread-out legs and other peculiarities, that he separated the Hippoboscidae from all other Diptera, at first as a distinct order Coleostoma (1802). Although he soon returned them to their rightful place, he kept them as one of the major dipterous divisions, which he successively called Coriaceae (1803 and 1805), Eproboscidea (1809) and Pupipara (1817), as mentioned before. On the strength of Latreille's authority the term Pupipara soon came into general use for one of the two or sometimes three suborders of Diptera, to cover the Hippoboscidae, Nycteribiidae, Streblidae, and later also Braulidae. It persisted as such long after it had been shown to be untenable.

Brauer (1863, pp. 32–34) proposed the next important departure in the classification of the Diptera. He divided the order into two major groups, the Orthorrhapha and the Cyclorrhapha, on the basis of the mode of emergence of the adult from the pupa, often correlated with the presence or absence of a ptilinal suture in the head.[12] The Cyclorrhapha, as he elaborated them a few years later (1869, pp. 850–852), comprised two main subgroups: (A) Proboscidea, with the two tribes, Pseudoneura (Syrphidae) and Eumyidae (Muscoidea, Conopidae, Pipunculidae, and Platypezidae); and (B) Eproboscidea, with one tribe, Pupipara (Hippoboscidae and Nycteribiidae). This arrangement embodied some of

[12] Brauer used originally the spelling Orthorapha and Cyclorapha. This seems to have been corrected first by Schiner (1864, p. 201) to Orthorhapha and Cyclorhapha, the form accepted by Brauer in 1869 (pp. 846 and 850). Becher (1882, p. 53) seems to have introduced the form Orthorrhapha and Cyclorrhapha, now in common use.

the features of Schiner's system (1864*b*, p. 211), which reverted to the use of Latreille's Eproboscidea, but omitted Pupipara.

Brauer was particularly concerned with establishing that the so-called "Pupipara" of Latreille and his successors, namely the ectoparasitic pupiparous flies, could not be ranked as one of the main divisions or suborders of the Diptera, nor as a taxonomic unit distinct from and equivalent to the Myiodaria. In 1883 (p. 11) he adopted the division of his Cyclorrhapha proposed by Becher (1882, pp. 49–54) into Aschiza and Schizophora, the latter alone being provided with a true ptilinum and a ptilinal suture. Shortly afterward (1885, pp. 392–413), he discussed the matter at length in the first attempt at placing the "Pupipara" in their proper phylogenetic setting. His views were stated concisely as follows (p. 393): "The Pupipara are adaptive forms which, to judge by their entire organization may be derived from Muscoidea Cyclorrhapha, the differences they show from these being explained by and produced through their parasitic habits, so that these insects have not been ancestral to any other dipterous family, but are a terminal side-branch of the Muscoidea." It is therefore erroneous to separate them as a taxonomic unit on a par with the Aschiza and the Schizophora, or to recognize three dipterous suborders, Nematocera, Brachycera and Pupipara. In either of these arrangements the true relationships of the "Pupipara" are lost. Brauer stressed that, although all larval instars of the so-called "Pupipara" develop within the mother's uterus, the larva is nevertheless a typical muscoid maggot, which changes by hardening of the integument into a typical muscoid puparium. Both larva and puparium possess the characteristic seams along which the puparium of the Cyclorrhapha opens when the adult emerges. Furthermore, a specialized ptilinum is present in the adult of the so-called "Pupipara" as well as of the Schizophora. Both features could not possibly have been acquired independently, in exactly the same form, twice in the course of evolution. At the time Brauer wrote, it was not known that the free-living Glossinidae (tsetse-flies) reproduce in exactly the same manner as the so-called "Pupipara," and that the structure of the genital tract and the larva are essentially the same in both these groups. Since it is agreed that the Glossinidae are specialized Schizophora, the peculiar adenotrophic viviparity (pupiparity) of the ectoparasitic Diptera can no longer be used as a valid argument to maintain the latter as a distinct, major taxonomic unit. Brauer's conclusion that the so-called "Pupipara" are merely highly specialized schizophorous muscoids has been accepted by nearly all modern dipterists.

Brauer evidently thought that the ectoparasitic pupiparous Diptera formed one phylogenetic branch of the Schizophora, as appears from his table of the relationships of the Diptera (1883, p. 12). Here he subordinates the tribe Pupipara to the Section Schizophora, placing it on a par with the tribe Eumyidae, the latter including both the Holometopa and the Schizometopa. This arrangement now appears artificial in that it probably does not reflect the true phylogeny of these insects. As shown by the following review, there is as yet no full agreement as to whether the Hippoboscidae, Streblidae and Nycteribiidae form a monophyletic (hence natural) or a polyphyletic (hence artificial) assemblage. Their possible relationships with particular types of Recent Cyclorrhapha Schizophora and specifically with certain other Muscoidea are even more controversial.

Much of the disagreement on these two points seems to have arisen from the persistent attempts to divide the Muscoidea dichotomously in two branches, each presumably forming a distinct monophyletic unit. The two main divisions are called variously Acalyptrata (or Acalypterae) and Calyptrata (or Calypterae), terms borrowed from Robineau-Desvoidy and Macquart (Schiner, 1864, pp. 49 and 73); Holometopa and Schizometopa (Brauer, 1880, p. 117); and Haplostomata (or Athecostomata) and Thecostomata (Frey, 1921, p. 208). These names reflect the type of character given preference by the several authors to define the two groups: calypteres, type of vertex in both sexes, and hyoid (or theca); although other characters have also been used occasionally. The limits assigned to the two groups vary widely, as no two authors seem to agree as to where to draw them. In general, however, the Acalyptrata (Holometopa or Haplostomata) contain most of the more primitive muscoids, none with distinct calypteres, most of them with a broad frons in both sexes, and nearly all without a hyoid. The Calyptrata (Schizometopa or Thecostomata) comprise what are undoubtedly the higher or more evolved muscoids (and some that appear more primitive, possibly due to degeneration), many of them with well-developed calypteres and the frons narrower in the male than in the female, and nearly all with a hyoid. Although the question is strictly speaking outside the scope of the present work, I venture to submit that it may eventually be dismissed as a false problem. There seems to be no compelling reason why the early phyletic evolution of the Muscoidea, as deduced from the Recent families, should have been necessarily dichotomous. The known fossil record is far too scant to be of much help; but the

wealth and variety of Recent types suggest that the ancestral Proto-Muscoidea were subject at various times to considerable adaptive radiation ever since the Cretaceous or Jurassic. Only some, perhaps only a few, of the lineages they produced survived to the present era. It follows that the comparative study of Recent muscoids can scarcely give enough factual data to express their early phyletic evolution in a formal, trustworthy genealogy. I suggest that endeavors to trace the relationships of the several Recent families by appraising their similarities and divergences of structure, in the adult and early instars, may be more enlightening than attempts to force them into a dichotomous scheme of doubtful phylogenetic meaning.

For our present purpose we are only concerned with the monophyly or polyphyly of the so-called "Pupipara," or the degree of relationship between the Hippoboscidae, Streblidae and Nycteribiidae, and more specifically between the Hippoboscidae and the other two families.

Brauer's monophyletic theory was accepted by Handlirsch (1924, **3**, pp. 1028–1030), who united all "Pupipara" in a single family Hippoboscidae, with 2 subfamilies, the Hippoboscinae (divided into the tribes Hippoboscini and Streblini) and the Nycteribiinae.

Townsend's views, expressed in his *Manual of Myiology,* varied from time to time, but on the whole show his preference for a monophyletic origin. At first (1935, *Op. cit.,* **2,** p. 81), he combined the Hippoboscidae and Streblidae only in a superfamily Hippoboscoidea, the sole component of his subsection Nymphipara [= Pupipara] of the Diptera Schizophora, the subsection being more or less on a par with his subsection Myiodaria. At the same time he referred the Nycteribiidae to his Hypocera (Cyclorrhapha without ptilinum = Aschiza of Becher). Later (1935, **2**, p. 292; 1938, **6**, pp. 243–244; 1938, **7**, p. 429), he transferred the Nycteribiidae to his Hippoboscoidea and added to them also the Braulidae. His Nymphipara and Hippoboscoidea were defined as follows: "Head of fly more or less closely united with thorax, not freely movable; neck vestigial or much reduced." It is scarcely necessary to point out that this definition is based on trivial characters, of secondary importance in the evolution of the group, and, moreover, does not cover some of the Hippoboscidae and Streblidae, nor any of the Nycteribiidae.

Crampton (1944*a,* p. 154) also united the Hippoboscidae, Streblidae, Nycteribiidae, and even the Braulidae in one superfamily Hippoboscoidea. This he included among the Platypezomorpha,

the second of his two main divisions of the Cyclorrhapha Acalyptrata, defined as follows: "characterized by having a normal, well-developed sixth sternite, which (when present) is not displaced into the insect's left flank." The second section of this division, the Lauxaniiformes, he also defined: "With reduced sixth sternite. Seventh sternite not distinct, amalgamated with inverted eighth sternite, which may become atrophied." The Lauxaniiformes he divided into two superfamilies, neither of which he defined, however: (1) Lauxanioidea ("derived from the Platypezidae") containing Lauxaniidae [= Sapromyzidae], Chamaemyiidae [= Ochthiphilidae] and Diopsidae; (2) Hippoboscoidea ("derived from Lauxaniidae [= Sapromyzidae] or Platypezidae [= Clythiidae]"), containing the four families mentioned above. It is difficult to see how the Hippoboscidae can have any real kinship with either the Sapromyzidae or the Clythiidae, or with the ancestors of these two families. The structure of the mouth-parts alone would seem to offer an unsuperable objection to Crampton's view. He seems to have attached undue phylogenetic importance to supposed homologies of the male terminalia and associated abdominal sclerites. These highly adaptive structures are simplified in the Hippoboscidae, Streblidae and Nycteribiidae by loss or atrophy of many of the primitive parts, to such an extent as to be practically worthless for tracing true kinship. To decide whether the few ventral sclerites retained by some of the Hippoboscidae are modified 6th or 7th sternites would seem to be mere guesswork.

G. H. Hardy (1944) grouped all ectoparasitic so-called Pupipara in one of his nine superfamilies, the Hippoboscoidea, evidently without previous knowledge of Crampton's similar action.[13] This superfamily he defines as follows: "Abnormal flies with coxae spaced widely apart and usually most or all abdominal segments are fused together. Parts of male terminalia are vestigial or eliminated. Flies parasitic on vertebrates." The broad, flattened sternum is the one structural character shared by all Hippoboscidae, Nycteribiidae and Streblidae, though it is not equally developed in all of them. It is due to the secondary spreading apart of the coxae, as Hennig (1941) has shown, and seems to have originated independently in several unrelated ancestral stocks of Diptera,

[13] Hardy was not particularly concerned with the phylogeny of the several members of his Hippoboscoidea, since he stated (p. 80) that "it is convenient to retain the superfamily until the affinities can be assured."

usually though not necessarily as an adaptation to successful ectoparasitic life. At first it may have been slight in extent, in the early stages of parasitism or during the more temporary association with vertebrate hosts which presumably preceded obligate parasitism. After the ectoparasitic relations became well established, the advantages for permanent life in feathers or hair of a flattened body with laterally inserted legs increased and the sternum became gradually wider. The present similarity between the sterna of the three families is most probably due to adaptive convergence. The dorsal fusion of the abdominal segments is not a general character of the three families, being scarcely developed in the males of the Nycteribiidae and not at all dorsally in the genus *Ornithoica* among the Hippoboscidae. Moreover, it is a sequel of a gradual reduction of the hardened areas or sclerites, and this reduction varies greatly among the several genera of Hippoboscidae. Various stages of reduction of the abdominal sclerites with concomitant fusion of the softer areas occur also in other free-living, so-called physogastric Diptera, as well as ventrally in the Glossinidae, in response to the need for a more expansible abdomen in order to store food or for reproductive purposes.

Some other dipterists have offered useful suggestions regarding the evolution of the Pupipara, without committing themselves for or against the monophyletic origin of these insects. Williston (1908, p. 62) merely wrote that "*Nycteribia* and *Melophagus* are perhaps the most specialized of all insects, that is they have traveled further from the starting point."[14] His acquaintance with the Pupipara seems to have been rather casual, to judge from his statement (1908, p. 58) that "it is even doubtful yet whether some of them may not be oviparous in habit; we know of one species, at least, wingless and parasitic upon birds which stands on the border line." This could only have referred to *Carnus,* which, however, has nothing in common with any of the "Pupipara." He also noted: "I believe there is a much closer relationship between

[14] The oviparous Braulidae, possibly ectoparasites but more probably commensals of honey-bees, appear to be structurally much more evolved than any of the louse-flies of vertebrates. Except that they are Schizophora, they have no close connection with the "Pupipara" and should not be considered in the present discussion. They have been regarded variously as related to *Thaumatoxena,* to the Sphaeroceridae (Hennig, (1941*b,* p. 231), or to the Drosophilidae (Hennig, 1952, p. 325).

the Streblidae and Borboridae, than between the Borboridae and Empididae, for instance.'' There may be some truth in a possible collateral kinship between the Streblidae and the Borboridae; but the comparison with the relationship between the Borboridae and the Empididae is rather pointless, since the former are Cyclorrhapha and the latter Orthorrhapha.

Massonnat (1909) made an elaborate comparative study of the structural specializations of several Palearctic Hippoboscidae and one species of Nycteribiidae, including also *Braula*. Unfortunately he covered too few hippoboscid genera and did not consider the Streblidae at all. It is not surprising therefore that, in spite of his industry, his views on the affinities of these insects are couched in very general terms. Nowhere does he state clearly whether he regards the Hippoboscidae and Nycteribiidae as one or two phylogenetic branches of the muscoid stock. So far as I can gather from his concluding remarks (pp. 339–342), he recognizes that the louse-flies are allied to the Muscoidea (''Muscides''), without defining to which particular type. As for the Nycteribiidae, he is even more vague, stating only that they evolved presumably (''vraisemblablement'') from the Muscoidea also (p. 341). This does not mark any real progress beyond what Brauer had established some years earlier.

Müggenburg (1892, p. 324) suspected from a comparative study of the head, antennae and mouth-parts that the Hippoboscidae and the Nycteribiidae probably had a different origin, although he recognized that both come from Cyclorrhaphous ancestors. The Hippoboscidae he was inclined to derive from the ''true Muscidae'' (higher Muscoidea), but offered no suggestion as to the possible ancestor of the Nycteribiidae.

Lameere's classification of the Diptera (1906, pp. 105–140; 1938, **5**, pp. 71–162) is perhaps the most ambitious attempt ever made to apply the principles of phyletic evolution to the order. He prefers to accept the two suborders Nematocera and Brachycera, a slight modification of an arrangement proposed by Osten Sacken. The Brachycera he divides into Orthorrhapha and Cyclorrhapha, the latter being further subdivided much as Brauer did in 1883. He does not consider the so-called Pupipara as a monophyletic unit on a par with the Eumyidae. Instead, he includes them among the Haplostomata (Acalyptrata or Holometopa) with the remark that ''probably they were derived from Haplostomata whose larvae lived in faeces, but from different types of Haplostomata'' (1938, p. 145). He suggests that the Hippobosci-

dae and the Gasterophilidae had a common ancestor, that the wing venation of the Streblidae, very different from that of the Hippoboscidae, recalls that of the Helomyzidae, and that the Nycteribiidae are presumably connected with the Borboridae.

Speiser, who was no doubt better acquainted with all three families of ectoparasitic "Pupipara" than any of his contemporaries, considered the problem of their origin and later evolution in some detail (1908, pp. 425–447). He attempted to tie it up with their present geographical distribution. Such an approach could only be successful if it were possible to correlate it with the present and past distribution and migrations of the hosts. His conclusion that each family was derived from a different branch of the large muscoid stock, is based, however, on sound morphological evidence. He states definitely that each branch acquired integral viviparity (pupiparity) independently, the final similarity in this respect being due to convergent evolution (p. 426). It is evidence of his sound judgment that he is most cautious in tracing the possible relationship of each family to a particular type of free-living muscoid. He finds it nearly impossible to even surmise the phylogeny of the Nycteribiidae, because of their extreme adaptive modifications, but recognizes that some of the unique nycteribiid specializations are foreshadowed among the Streblidae. The Streblidae he regards as a monophyletic unit in spite of their great diversity, but offers no suggestion as to their nearest free-living relatives, except for a reference to the similarity in wing venation between *Nycteribosca* and the Borboridae (p. 439). He is, however, much more positive in the case of the Hippoboscidae, pointing out (p. 446) that the genus *Glossina* (in the broad sense) "is from all appearances the closest relative of the hippoboscids among the present-day muscoids."[15]

Muir (1912, p. 365) considers the Pupipara as polyphyletic branches of the Muscidae, in the paper in which he established that *Ascodipteron* cannot be separated from the Streblidae. Beyond this he does not express an opinion.

Falcoz (1926, pp. 8–9) is much more explicit than any earlier author. He states that the Hippoboscidae are connected with the Muscidae, through *Glossina,* a view adopted from Speiser. The Streblidae and Nycteribiidae seem to him related respectively to

[15] "Dieser Gattung [*Glossina*] stehen die Hippobosciden unter den heute lebenden Musciden allem Anschein nach am allernächsten."

the Borboridae and Helomyzidae, "since they are derived presumably from cavernicolous ancestors belonging to these families and living in guano."

Jobling (1929, p. 443) originally concluded as follows, from a study of the head capsule, antennae and mouth-parts: "The structure of the head and its appendages in the Pupipara shows that the Hippoboscidae are related to the Muscidae. As regards the relations of the Streblidae and the Nycteribiidae, it is only possible to say that they are descended from the Acalyptrata. The striking resemblance, especially as regards the proboscis, is due to the phenomenon of convergence." As late as 1949 (p. 321) he maintained that "the ancestors of the Streblidae were non-blood-sucking flies which undoubtedly had some resemblance to the present Acalypterae." More recently (1951, pp. 212 and 244), however, he changed his earlier views, after studying the thorax and abdomen more completely, and he now agrees with Hennig (1941) that the Streblidae are related rather to the Calyptrata. Either view can be correct if the Pupipara are polyphyletic. Jobling's chief merit was to point out the essential difference in the structure of the haustellum between the Hippoboscidae and the Nycteribiidae-Streblidae. In the latter, the slender portion of the haustellum beyond the swollen, bulbous base and which enters the skin, consists only of the elongated labella; whereas in the Hippoboscidae the labella are very short and only an insignificant part of the haustellum (1929, pp. 436–438).

In a detailed discussion of the phylogeny of the Diptera, Hendel (1936, pp. 1876–1877) states definitely that the ectoparasitic so-called Pupipara (or Eproboscidea) are certainly not monophyletic. Their further relationships within the Schizophora he regards as problematical, the Nycteribiidae being possibly evolved from cavernicolous (troglophilous) Acalyptrata. He considers that the Hippoboscidae are perhaps related to the Gasterophilidae which he places among the Acalyptrata. In the taxonomic section of the same work (1936, pp. 1980–1984) the three families Hippoboscidae, Streblidae and Nycteribiidae are nevertheless grouped together as "Eproboscides (Pupipara)" within the frame of the Schizophora Acalyptrata; but as this section was edited posthumously, it cannot be regarded fairly as expressing Hendel's own views.

Hennig (1941, p. 248; 1951, p. 275; 1952, pp. 400–407) has given more thought to the problem than any of his predecessors, marshalling all important available evidence. He studied in detail the widening of the ventral areas of the meso- and metathorax

characteristic of all ectoparasitic Pupipara, which pushes the mid and hind legs to the sides of the body. It should be noted that wide "sternal areas" are not restricted to the "Pupipara," but occur also in the Braulidae, which are not pupiparous and do not live on vertebrates, and in at least one of the Tipulidae (*Gnophomyia*), which are not Cyclorrhapha. Moreover, the distance between the coxae in each of the mid and hind pairs varies somewhat among the other Diptera. Hennig was able to show that the occasional unusual widening of the "sternal areas" is not due to a reversal of the cryptosterny, which is an essential feature of the dipterous thorax. The internal structures connected with cryptosterny remain unchanged, but the mid and hind coxae shift position within the original laterosternites, producing in *Hippobosca* an internal double bottom (pierced with a median window) on the ventral side of the metathorax, connected with a fold of the ventral wall of the metathorax. The widening of the sternal areas is therefore a secondary phenomenon, which undoubtedly occurred at various times independently during the evolution of the Diptera, particularly as an adaptation to successful permanent ectoparasitic life. Hennig investigated also the male terminalia, the abdominal segments and spiracles, the second antennal segment, the prestomal teeth of the labella, and the hyoid of the tentorium. These structures, he believes, suggest that the Hippoboscidae, Nycteribiidae and Streblidae are all Calyptrata. Perhaps, as I suggested, the distinction between Calyptrata and Acalyptrata is not as fundamental as is now commonly thought. In any case, it has no direct bearing on the monophyly or polyphyly of the three families, a problem the solution of which is not particularly helped by most of the structures Hennig examined.

Moreover, I am in full agreement with Hennig's general conclusion (1951, p. 275) that the ectoparasitic so-called Pupipara "are a conglomerate evolved by polyphyly and cannot be maintained as one taxonomic unit; they comprise two phylogenetically homogeneous groups, which probably should rank as families, the Hippoboscidae on the one hand and the Nycteribiidae-Streblidae on the other, both to be placed near the Muscidae." He reiterated much the same views in his recent monumental work on the larvae of the Diptera (1952, p. 401), where he pointed out in addition that the larvae of the Hippoboscidae differ in many ways from those of the Nycteribiidae and the Streblidae, although the latter two are superficially known at present in the larval instars.

Hippoboscidae a Monophyletic Family. The Hippoboscidae are so uniform in all essential internal and external structures, as well as biological features, that even the most aberrant members, such as *Myiophthiria* and *Melophagus,* are obviously louse-flies and easily placed near their more normal relatives. All agree in the much flattened head and thorax, the leathery integument, the position of the frons in a plane with the mediovertex and vertex, the flattened antennae with the 3rd segment much reduced and imbedded in the 2nd, the sheath-like palpi enclosing a needle-like haustellum, the very short terminal labella of the labium, the dorsally placed prothoracic spiracles, the broad intercoxal sternal areas bearing the legs spread out from their side edges, and the greatly simplified male terminalia. The rostrum membrane and the basal portion of the haustellum are always retractile within the head capsule. In the few genera that have been examined for the purpose, the tentorium is provided with a hyoid and the other internal structures vary only in minor details. It is most improbable that an integrated complex of so many unusual features could have arisen more than once in the course of evolution; most if not all of these peculiarities were present at least to some extent in the hypothetical Proto-Hippoboscidae. In spite of the almost complete lack of paleontological evidence, we may postulate that all Recent hippoboscids evolved from a single ancestral proto-hippoboscid stock.

The monophyletic unity of the family is also brought out by the relatively few characters available for the definition of supra-generic groups. Owing to their more primitive condition, the Ornithoicinae possess several distinctive features, namely in the antennae, frons and abdominal segmentation; but, even so, their kinship with the Ornithomyiinae is undeniable. The Ornithomyiinae also are unique in having deeply split claws and a strongly concave anterior margin of the prescutum, both adaptive specializations. None of the other four subfamilies have a single feature not shared by one or more of the others, so that each must be defined by a combination of characters, indicating how similar they are in spite of great differences in host preferences. Few of the characters of subfamilial value seem to be adaptive to a special type of host, although the appreciation of adaptiveness will always be to some extent subjective. It is more to the point that some of these characters, though present in all members of one subfamily, are nevertheless only of generic value elsewhere in the family.

The monophyly of the Hippoboscidae would scarcely call for

discussion, were it not that Bezzi (1916, p. 157) advocated a most peculiar multiple origin for the Pupipara, in which he derived some of the hippoboscids from two distinct lineages. Like many another bizarre theory, Bezzi's hypothesis is bound to fascinate those who are only superficially acquainted with the subject. It should be noted that Bezzi considered almost exclusively the few subapterous and apterous forms. He divided these in three series, one comprising hippoboscids of mammals (*Allobosca, Melophagus, Echestypus* and *Lipoptena*), another bird-flies (*Crataerina, Stenepteryx, Myiophthiria* and *Brachypteromyia*), and a third the Streblidae and Nycteribiidae of bats. He then went on to say (translated from the Italian): "It is fairly probable that each of these series was derived by itself from a different form of higher, middle and lower Myiodaria. The phenomenon of wing reduction should be given great importance in the elucidation of their phylogeny, as yet shrouded in mystery. *Allobosca* must be a very old form, like the Australian *Ortholfersia,* which, moreover, has retained the wings; it is not possible at present to offer a hypothesis concerning its origin. The other three genera found on mammals probably evolved from higher Myiodaria related to *Calliphora,* a group containing many cuticolous forms. The genera living on birds originated probably from nidicolous acalyptrate lower Myiodaria, perhaps Dryomyzidae, a family which contains *Neottiophilum.* It seems to me that the case of *Carnus* illustrates very well the transition from a winged nidicolous acalyptrate to an apterous ectoparasite of a bird. The Old World Streblidae are possibly derived from Acalyptrata, particularly from cavernicolous Borboridae living in guano; those of the New World perhaps from other Acalyptrata, possibly Helomyzidae. The Nycteribiidae, in which the primitive shape is even more modified and which flourish in the Old World, may have had a similar origin." In so far as they concern the Hippoboscidae, these statements are certainly misleading. From their external and internal organization the louse-flies form a compact unit, regardless of the development, reduction or loss of the wings. In the subfamily Ornithomyiinae, all of which live permanently on birds only, the relationships between the winged and the subapterous forms are very close and there is no evidence that any of them could have originated from a different line of free-living ancestors; the same is true of the Melophaginae of mammals. In tracing the conjectural ancestors of the Hippoboscidae, the emphasis should be on a study of the fully-winged

genera, which have retained more of the primitive characters than the subapterous and apterous forms.

Relationship with Glossinidae. From the foregoing critical review of the opinions and evidence bearing on the problem, one may conclude that the Hippoboscidae are phylogenetically dissociated from the Nycteribiidae and the Streblidae. Further attempts to trace their origin are confronted with a complete lack of evidence, either in the Recent or in the fossil fauna, on which a hypothetical proto-hippoboscid could be reconstructed, as even the relatively primitive Ornithoicinae are too specialized for the purpose. Nevertheless, it would seem that the Glossinidae or tsetse-flies are most closely related to the Hippoboscidae among the Recent Diptera. The Glossinidae are a small, sharply defined family of free-living, blood-sucking higher Muscoidea, sharing adenotrophic viviparity (so-called "pupiparity") with the louse-flies. The two families show so many striking similarities, that the homologies of many external structures of the Hippoboscidae can most easily be traced by assuming that they are dorso-ventrally flattened *Glossina*-like flies.

Speiser (1908*c*, p. 446) first recognized that the genus *Glossina* was to all appearances the nearest relative of the Hippoboscidae among the present-day muscoids. Roubaud (1909, pp. 478–487) discussed some of the similarities between the two families, but concluded that they were due to adaptive convergence and not to phylogenetic kinship. Bezzi (1911, p. 119), on the other hand, claimed that the genus *Hippobosca* was closely related to the Glossinidae. In a table annexed to his paper (1911), he even derived the subfamily Hippoboscinae from the Glossinidae (or subfamily Glossininae). Bezzi thought, however, that the other Hippoboscidae did not show the same relationship, since he claimed in a later paper (1916, p. 157) that the family as a whole had a polyphyletic origin, a view with which it is impossible to concur. Zavattari (1928) extended Bezzi's theory to all the Hippoboscidae, though more specifically to *Hippobosca, Pseudolynchia* (= *Lynchia maura*), *Crataerina,* and *Melophagus.* His comparisons are exhaustive and should be consulted for additional details bearing on the present argument. He concluded that there is between the Glossinidae and the Hippoboscidae "a close bond of relationship and that the tsetse-flies represent a stage connecting the non-parasitic forms of Muscidae with the Hippoboscidae, obligate parasites highly adapted to this peculiar mode of life." He did not discuss the details of their phylogeny, merely agreeing with Bezzi's earlier claim that the Hip-

poboscinae were derived from the Glossinidae. At one time (1942*a*, p. 39, footnote) I was reluctant to follow Bezzi and Zavattari in this matter and I attributed the evident similarities between the two families partly to the retention of archaic characters shared by all primitive Proto-Myiodaria (the ancestors of both hippoboscids and tsetse-flies) and partly to adaptive convergence. A more careful comparative study of these insects, particularly of certain more generalized bird-flies (Ornithoicinae), has now led me to reverse my previous stand to some extent.

Both the Glossinidae and the Hippoboscidae are fully mature groups, sharply set off from the other Recent Diptera, as well as from each other, by an assemblage of important external and internal features. They must therefore be regarded as relatively old, since they needed sufficient time to become so highly specialized, each in its own way. The customary, well-known difficulty of appraising the relative importance in phylogeny of the several differential characters, becomes more arduous than ever in such ancient, mature and deeply modified insects. What few primitive characters may remain are not merely obscured, but actually submerged by the extreme specializations.

That the Hippoboscidae are of some geological antiquity is shown by their highly evolved structure. It is further supported by the recent discovery of an Oligocene species of *Lynchia* (discussed before) as fully specialized as any of the Recent forms of this genus. The evidence that the tsetse-flies are at least equally ancient is even clearer. Several recognizable species of Glossinidae are known from the Florissant shales (Miocene) of North America, showing that the family was flourishing and possibly cosmopolitan during late Tertiary. The most surprising feature of these fossils is that they differ only in minor details from the Recent African species. We are forced to the conclusion that the ancestral Proto-Glossinidae must have lived during the Eocene or possibly late Cretaceous periods. If both the Hippoboscidae and Glossinidae arose from a common muscoid-like stock, this ancestral group must have been even older, possibly dating from the middle Mesozoic.

The free-living Glossinidae have retained more of the primitive muscoid features than the ectoparasitic Hippoboscidae, the several parts of the body and the appendages being shaped much as in the common muscoids, such as the house-fly (*Musca*). Like these, the tsetse-flies have the head (Part I, p. 16, Fig. 3*D*) vertical, swollen and hemispherical, freely movable on a narrow neck connecting the center of the occiput with the pronotum. The frons, or long an-

terior vertical area of the face, forms an angle with the vertex or posterior, nearly horizontal part. The small clypeus is a short, transverse sclerite beneath the anterior margin of the frons, at the extreme base of the proboscis. The eyes are large, broadly separated in both sexes and bare; 3 ocelli are well developed. The antennae, placed close together on a small lunula, fill most of a median, undivided, deep antennal cavity (depressed frons) below the ptilinal suture and between the strong lateral facial ridges. The 1st and 2nd antennal segments are very small, the 2nd split on the outer surface over its whole length; the 3rd is very long and bears near the base a thick, twice-feathered arista, with a single outer row of long, soft setae, each in turn provided with 2 rows of short hairs. The proboscis, hidden at rest between the long, straight, cylindrical maxillary palpi, forms a straight, needle-like haustellum whose structure duplicates that of the Hippoboscidae, but which is not retractile at the base. The thorax (Part I, Figs. 8*B*, 9*B*, and 10*B*) is slightly depressed, though scarcely more than in some other Muscoidea. It shows the usual sutures, furrows and dividing lines, as well as most of the groups of bristles, of the Calyptrata; the hypopleurite (meropleurite 2) lacks hypopleural bristles. Malloch (1929, p. 553) noted the absence of the sclerotized "prosternal plate" (Ferris' intercoxal area of preëpisternum) found in other Calyptrata and correlated this with the bulbous base of the haustellum. The subscutellum, behind and below the scutellum, is distinct but moderately convex. The prothoracic spiracles are on the vertical sides of the propleura, rather far down. The legs are long and inserted beneath the thorax in the usual muscoid manner, close to the median sternal line. The coxae in each pair are narrowly separated by a slight secondary widening of the sternal area. The claws are long, slender, curved, simple, without strongly developed heel; the two pulvilli are very broad, pad-like, with many minute tenent hairs on the under surface; between the pulvilli there is a bristle-like empodium. The wings are well-developed and show a typical muscoid venation with four complete cross-veins in the disk (anterior cross-vein or *r-m;* discoidal cross-vein or *m;* anterior basal cross-vein or M_3; and anal cross-vein or Cu_2); the apical stretch of the 4th longitudinal vein is straight, not bent nor angular. A characteristic feature of the venation is the strong downward bulge of the first basal cell at the anterior cross-vein, also present, moreover, though less marked, in one of the Hippoboscidae (*Olfersia sordida*). The membrane of the wing is finely and somewhat radiately rilled, and entirely cov-

ered with very small microtrichia (also over the alula and both calypteres). The two calypteres or squamae, as well as the alula, are well developed, the calypteres differing only moderately in size. The halteres are large, not hidden by the calypteres. The dorsum of the abdomen is completely covered by clearly divided, sclerotized tergites, which, however, stop sharply at the lateral edges. The ventral integument is soft, membranous; except for a fairly large sclerotized basal sternite, followed by a minute median sclerite, its segmentation is merely indicated by transverse folds. The 7 pairs of spiracles lie in the ventral membrane close to the edges of the tergites. The male terminalia are large and elaborate; at rest they are folded beneath the tip of the abdomen and completely hidden by a reflexed dorsal sclerite. The internal anatomy is similar to that of the Hippoboscidae, particularly in the structure of the genital organs. The single oesophageal diverticulum or storage crop is, however, functional and expands greatly when filled with blood. The integral or adenotrophic viviparity duplicates almost exactly that of the Hippoboscidae; but the newly-voided, full-grown third larval instar is sufficiently mobile to burrow in loose soil or dirt. The larva and puparium are like those of the Hippoboscidae, particularly in the presence of terminal respiratory swellings, which are even more pronounced than in the louse-flies.

At first glance, the Hippoboscidae differ greatly from the tsetse-flies, owing to the strong dorso-ventral flattening of the body, particularly of head and thorax. This has entailed shifts in the relative position of certain areas, fusion of some of the sclerites, and especially a considerable extension of the sternal areas between the insertions of the coxae. If these features are taken into account, there is little difficulty in correlating the various areas of the head and thorax of a hippoboscid with those of a tsetse-fly. One major discrepancy is in the structure of the hippoboscid antenna, which by no feat of the imagination can be derived from that of *Glossina* and is an important evolutionary departure from the hypothetical common ancestral muscoid stock. On the other hand, there is little difference in the proboscis, except that in the louse-flies the bulbous base and much of the needle-like portion of the haustellum are retractile within a ventral pouch formed by the rostrum membrane, when not in use. The similarity of the mouth-parts, even in detail, between the two families is astounding, considering the many and far-reaching changes involved in developing such a specialized proboscis from the usual, primitive "sponging"

type of most Muscoidea. Likewise, the structure of the internal genital organs of both sexes is almost the same in the Glossinidae and Hippoboscidae, as is also the type of adenotrophic viviparity. There is, however, much difference between the two families in the structure of the external male terminalia. The wing venation varies within the family Hippoboscidae and does not indicate true relationships. While that of *Hippobosca* differs conspicuously from the tsetse-flies, that of the more primitive *Ornithoica* is more like them, differing essentially only in the lack of the discoidal cross-vein. The absence of the discoidal cross-vein, resulting in the fusion of the discal and 2nd posterior cells, is an outstanding peculiarity of all Hippoboscidae. The rilled wing membrane of Glossinidae is present also in *Hippobosca,* but absent or barely indicated in other louse-flies. The development of the alula and calypteres varies greatly in the Hippoboscidae.

While it seems impossible to derive the Hippoboscidae directly from a tsetse-like ancestor, it is most improbable that the complex specializations of the mouth-parts and of the inner reproductive organs could have arisen independently on two occasions from ancestral muscoids and then developed further to the point of almost exact duplication. A more logical surmise is that the free-living Glossinidae and the ectoparasitic Hippoboscidae are diverging, ancient offshoots from a single stock which had previously acquired both the same type of sucking haustellum and integral, adenotrophic viviparity. As the body structure of tsetse-flies does not suggest an earlier adaptation to permanent ectoparasitism and it is unlikely that a permanent ectoparasite would return to a free blood-sucking life, the common ancestors may safely be stated to have been free-living. At the same time they were most probably mainly, if not wholly, hematophagous, as suggested by the fact that in the Recent fauna all known insects with integral viviparity are restricted to a diet of vertebrate blood. The kinship between the Hippoboscidae and the Glossinidae is therefore collateral and based only on a very ancient common ancestry.

III. Earliest Hosts of Hippoboscidae

The origin and further differentiation of the louse-flies are obviously tied up with the rise and evolution of the vertebrate hosts, so that it would be helpful if the original type of host could be determined with some degree of probability. In the absence of positive clues based on the fossil record, one can only speculate. The view expressed some years ago (J. Bequaert, 1942*a*, p. 41) that the

true Hippoboscidae or their ancestors, the Proto-Hippoboscidae, became established permanently first on birds, still appears most probable. If such was the case, the mammal-flies were derived later and at various times from several bird-flies, all of which had previously acquired the essential family characteristics.

The present-day Hippoboscidae are restricted to warm-blooded vertebrates and there is no reason to suppose that the ancestral Proto-Hippoboscidae evolved on anything but homoiotherm hosts. Hennig (1941*b*, p. 247) mentions Speiser's suggestion that the ancestors of the Hippoboscidae might have been parasites of reptilian ancestors of birds and mammals and rightly dismisses the idea as fantastic.[16] The problem of the original hosts is thus restricted to a choice between birds and mammals.

1. In the Recent fauna bird-flies far outnumber those of mammals in genera and species. Of the 20 genera here recognized as valid, with 121 to 124 recognizable species, 12 genera (60 per cent) with 88 to 90 species (72 per cent) live normally on birds only and never breed on another type of host. Nevertheless, these bird-flies form only two lines of descent or subfamilies: the primitive Ornithoicinae (1 genus with 6 or 7 species) and the more advanced Ornithomyiinae (11 genera with 82 or 83 species). One additional bird-fly belongs in the Hippoboscinae. On the other hand, the far fewer louse-flies of mammals, 33 or 34 species in 8 genera, are placed in four subfamilies: the Hippoboscinae (1 genus with 7 species on mammals), the Alloboscinae (1 genus with 1 species), the Ortholfersiinae (2 genera with 4 or 5 species), and the Melophaginae (4 genera with 22 species).[17] Of course, the argument based

[16] It seems doubtful that Speiser (1908*c*, p. 446) was as definite in his statement as Hennig implies. The passage to which Hennig seemingly alludes is so nebulous that I do not venture to translate it, but prefer to cite it in the original German: "*Glossina* saugt nach R. Koch mit Vorliebe das Blut der heutigen grossen Saurier, der Krokodile, *Ortholfersia*, nahezu die ursprünglichste unter den Hippoboscidengattungen, bewohnt Beuteltiere! Einmal von Sauriern über Beuteltiere zu höheren Säugern, und zweitens von einer *Glossina* ähnlichen Fliege über *Ortholfersia* ähnliche Tiere zu den heutigen Hippobosciden?" I may point out that *Ortholfersia* is a highly specialized fly as compared with the much more primitive *Ornithoica* of birds.

[17] Future discoveries will alter the absolute numbers of recognizable species and perhaps even of genera; but they will probably not affect appreciably the ratio of bird-flies to mammal-flies.

on the present-day relative strength is open to objections. First, not all the smaller subfamilies are restricted to mammals. Furthermore, these small subfamilies are probably all relicts of relatively archaic groups, of which only a few species survived in the Recent fauna, so that it might be important to know their approximate geologic age, concerning which the fossil record is silent. It is true that the only known fossil hippoboscid (*Lynchia rottensis*) is unquestionably a bird-fly; but it is so similar to the living species and is of such relatively late age (Oligocene), that it throws no light on the problem. The very fact that the Recent Ornithomyiinae of birds are more prolific and, in addition, show signs of relatively late evolution, as shown in the sequel, might conceivably point to a more recent origin for this subfamily. It could indeed be argued that louse-flies became more numerous and more varied on birds merely because the soft and dense plumage offered them a more favorable environment than the coarser and looser pelt of mammals, on which the ancestral Proto-Hippoboscidae (in this view) possibly had originally acquired the ectoparasitic habit.

2. All Recent Hippoboscidae are highly modified from the original muscoid type and, as the fossil record shows, they were so by mid-Tertiary at the latest and presumably much earlier. It is therefore difficult to recognize and appraise the primitive characters retained by the several subfamilies. Specialized types occur both on birds (*Myiophthiria*) and on mammals (*Melophagus*). *Melophagus* is often regarded as the extreme specialization among the Hippoboscidae; but I shall attempt to show later that *Myiophthiria* is better entitled to this distinction. It is true, nevertheless, that the most generalized louse-flies known (Ornithoicinae) are found nowadays on birds only. Moreover, some of the fully-winged Ornithomyiinae are decidedly more primitive than any of the winged louse-flies of mammals. This type of argument may be somewhat more convincing than the first; although it could be objected that the extreme specialization of some of the Recent mammal-flies predicates a very long evolution on the same general type of host, possibly older than that of the bird-flies.

3. The early geologic history of birds and mammals may conceivably throw further light on the problem. As shown before, the hypothetical Proto-Hippoboscidae originated, presumably during Cretaceous times (mid to late Mesozoic) or even earlier, from a free-living, blood-sucking, pupiparous myiodarian stock, by acquiring the habit of remaining permanently on the vertebrate host between blood meals. If they were induced to stay on the host,

either by the constant and higher temperature of the skin or the search for greater security in the body cover, which seems at least plausible, a dense cover of finely divided, soft, overlapping feathers may have been more attractive and more suitable than the simple, relatively loose and often coarse pelt of most mammals. Birds, as compared with mammals, offered an added advantage to the flies in that their thinner and softer skin is more easily pierced by the mouth-parts.

As is well known, both the true mammals and the true birds started independently from terrestrial reptilian stocks at about the same time in the Earth's history. Geologically speaking, mammals are slightly the older, as first traces of them appear in late Triassic deposits, while the oldest known birds date from the Jurassic (Lambrecht, 1933; Howard, 1950). However, birds seem to have become differentiated to their present variety more rapidly than mammals and consequently may have offered sooner a prolific choice of types attractive to ectoparasitic flies. The earliest Jurassic birds were perhaps only sparingly feathered, much of the body being possibly covered with scales or structures transitional between scales and feathers. During the Cretaceous, however, there were several dissimilar types of birds, some of them essentially similar to Recent forms (Lambrecht, 1933; Howard, 1950). There is little doubt that many Cretaceous birds had a plumage fully adequate for ectoparasitic insect life. Meanwhile the primitive mammals persisted; but the Mesozoic fossil record shows only a few types all of small size (averaging that of rats and mice), similar in appearance and possibly also in habits to the Recent Insectivora. What their pelt was like or whether they even had hairs instead of scales, is unknown. It may be pointed out that no Recent Hippoboscidae are known from the orders containing only small mammals, specifically from the Insectivora and Rodentia. The scarcity and small size of the Mesozoic mammals seem to make them most improbable hosts for the ancestral Proto-Hippoboscidae, particularly as many more satisfactory bird hosts were available. There is, moreover, every reason to believe that the Hippoboscidae had acquired most or all of their characteristic features of structure, physiology and behavior before the close of the Mesozoic or early in the Cenozoic.

In this connection, I have shown (Part I, pp. 246 and 313–314) that there is a sharp contrast between the large variety of types of birds used for breeding by Recent louse-flies and the few types of mammal hosts. While the bird-flies are associated with 18 out of

the 27 major groups or orders of Aves, the hosts of the mammal-flies belong to only 5 out of the 18 orders of Mammalia. Moreover, most mammal-flies live on Artiodactyla and only a few are associated with Carnivora (*Hippobosca longipennis*), Marsupialia (in Australia only), Primates (lemurs, in Madagascar only), or Perissodactyla (in domestication only).

4. In the discussion of the probable origin of the ectoparasitic habit which is to follow, I suggest that the earliest stages of the structural adaptations to ectoparasitism may have been acquired when the ancestors of the Hippoboscidae were blood-sucking muscoids living as yet freely in or near the nests of the hosts. The need for adequate shelter between meals was possibly the original selective factor determining a gradual flattening of the body and spreading of the legs. If this was the case, the nesting habits and types of nests of birds were probably more suitable for such an evolution than the burrows or other temporary resting places of most mammals. As noted before (Part I, p. 120), the adaptive structures now characteristic of the Hippoboscidae seem to be more advantageous in plumage than in pelt and are also more marked in the bird-flies.

The foregoing considerations seem to warrant the conclusion that, although no certainty can be reached in the matter, birds were most probably the first hosts of the earliest true Hippoboscidae. It follows that all mammal-flies must have been derived from bird-flies. The further discussion of the evolution of the family will be based on these two conjectures.

IV. Evolution Within the Family

All Hippoboscidae, from the most primitive (*Ornithoica*) to the most specialized (*Melophagus* and *Myiophthiria*), have an unmistakable family air, due not so much to the depressed thorax and spreading legs (also found in the Streblidae and the Nycteribiidae) as to the wedge-shaped head with the flattened face and large eyes (present in no other Diptera). These features and some others are clearly adaptations to obligate ectoparasitism on warm-blooded vertebrates covered with feathers or hair (Part I, p. 120). It may be of interest to inquire whether closer adaptive correlations can be recognized between the several types of louse-flies and the taxonomic kinship or ecological peculiarities of their special breeding hosts. From what is to follow it would seem that such correlations are exceptional above the generic or specific level of the flies.

The evolution of the Hippoboscidae no doubt paralleled that of

their vertebrate hosts. A wealth and diversity of appropriate hosts must have resulted in an abundance and variety of louse-flies. The evolution of birds seems to have been more gradual, less explosive and more conservative than that of mammals, and relatively more of the major groups (orders) it produced seem to have survived to the present day. By Eocene times most of the Recent orders of birds were clearly distinguishable and several family divisions were apparent (Howard, 1950, p. 4, fig. 1). These circumstances possibly explain why the Recent bird-fly fauna is at once richer in species and genera and more uniform in supra-generic characteristics. In marked contrast, the few Recent louse-flies of mammals belong to four distinct subfamilies, each of which seems to have evolved by itself from its own ancestral bird-fly. The many successive Tertiary types of mammals offered excellent opportunities for the development of such mammal-infesting flies.

There is actually no single character or set of characters separating all mammal-flies from all bird-flies, although certain peculiarities or tendencies may be more marked or more frequent in one of the groups. This statement remains true even if we choose to ignore the one species of *Hippobosca* of the ostrich as a taxonomic aberration. All louse-flies, of mammals as well as of birds, have two claws on every leg, although the claws are sometimes unequal in the pair in the mammal-flies. While the bird-infesting Ornithomyiinae have claws with split tips, and the Hippoboscinae, Melophaginae, Alloboscinae and Ortholfersiinae of mammals have simple-tipped claws, the Ornithoicinae of birds have simple claws like the mammal-flies. Split claws may be useful to the bird-flies in helping to adhere to the feathers and may thus have a decided adaptive advantage; but *Ornithoica* shows that they are not essential for survival in plumage. On the other hand, simple claws are quite suitable to life in pelt and were therefore retained by the mammal-flies from the primitive Proto-Hippoboscidae, which it is believed first developed on birds. Various other characters are sometimes claimed to be peculiar either to bird-flies or to mammal-flies, such as the shape or size of the antennae, the thick or slender shape of the legs, and the presence or absence of ocelli, but only because of superficial acquaintance with the family as a whole. Müggenburg (1892, p. 320) noted that the haustellum of the mammal-flies he examined (*Melophagus, Lipoptena* and *Hippobosca*) was very slender, whereas that of the bird-infesting *Crataerina* was relatively shorter and thicker. He correlated this with the thinner skin of birds, which is also more poorly provided with

capillaries than that of mammals. He thought that bird-flies required only a relatively short haustellum, but one making a wider gash than the longer and more slender haustellum needed to imbibe blood from a mammalian skin. A comparative study of the haustellum throughout the family shows, however, that the supposed difference is so slight and so difficult to appreciate, that it could not be used as a subfamily character.

The relatively few apterous and subapterous flies show more marked structural adaptations to definite types of hosts than the fully-winged forms. The two completely apterous species of *Melophagus* are eminently adapted to life in the dense under wool of their very special hosts. The subapterous *Crataerina, Stenepteryx* and *Myiophthiria* also are built ideally for survival in the closely packed plumage of the fast-flying swifts and swallows, to which they are wholly restricted. As described in the sequel, the special adaptations of these flies are foreshadowed in certain fully-winged species of *Ornithomyia* likewise restricted to swallows.

No such close correlations between structure and type of host can be traced among the fully-winged louse-flies, whether of birds or of mammals. As a rule it is impossible to surmise on purely morphological grounds what type of host a fully-winged fly might prefer. The dearth of special adaptations is obviously correlated with the low degree of host-specificity of many of these flies. It is well illustrated by the genus *Lynchia,* the largest of the family, in which some species breed successfully on a variety of unrelated birds (*L. americana* on members of 3 orders), while others are more host-restricted but prefer different types of birds (*L. hirsuta* on Galliformes; *L. nigra* on Falconiformes and Strigiformes; *L. albipennis* on Ciconiiformes; *L. angustifrons* on Falconiformes; *L. pilosa* on Otididae in the Gruiformes; *L. holoptera* on Rallidae in the Gruiformes; etc.). The structural characters separating these species are scarcely adaptive to the particular type of preferred host; so that the host selectivity of these flies must be correlated with physiological or ecological adaptations. Similar conditions prevail in *Olfersia* among the bird-flies and *Hippobosca* among the mammal-flies. In addition, *Hippobosca* has evolved a species restricted to a bird, the ostrich, and this fly shows no great morphological departure from its congeners.

In the Hippoboscidae, the dearth of Recent genera and species contrasts sharply with the structural diversity as expressed by the six subfamilies. Each of these appears to be a distinct line of descent, as no connecting links are known. The distinctiveness of

the subfamilies suggests that they are ancient lineages, presumably remnants of an early, more profuse adaptive radiation of the louse-flies which reached its peak when the mammals and birds were at their height and has declined ever since. The peak may have been during the Miocene, when the Artiodactyla, now the chief hosts of the mammal-flies, were also particularly flourishing. Facts based on the fossil record are lacking to allow further speculations about the origin of the subfamilies.

It is possible, however, to recognize within some of the subfamilies certain trends of evolution, often correlated with host-specificity. They are not claimed to represent actual lines of descent, but merely illustrate some of the types of change which occurred in the course of the past evolution of the family.

1. **Ornithoicinae the Most Primitive Hippoboscids.** The Ornithoicinae are of unusual interest because they are indubitably the most primitive Recent hippoboscids. Typical Hippoboscidae in all essential characters and easily recognized as such, they nevertheless retain some features believed to have been characteristic of the hypothetical Proto-Hippoboscidae. The first antennal segment is large and completely divided from the frons; the interantennal area of the frons (frontal carina) is very narrow, sunken and not visible between the paired first antennal segments, which are in contact on the middle line; ocelli are present; the thorax is moderately flattened, with a nearly straight anterior prescutal margin and broadly rounded, barely projecting humeral callosities; the notopleuron is completely separated from the prescutum; the prosternum forms an undivided, trapezoidal sclerite between the fore coxae; the tarsal claws are simple; the wings are functional throughout adult life and provided with a large alula and the complete venation for the family; in both sexes the dorsum of the abdomen is extensively covered by large median sclerites. The only known genus is world-wide and most of the few species are polyxenous on many unrelated birds.

2. **Evolution in the Ornithomyiinae.** Sharply contrasting with the Ornithoicinae, the Ornithomyiinae contain some of the most specialized louse-flies and certainly the most evolved of the bird-flies. This is shown by the following combination of characters all of them share. The first antennal segment is very small and more or less fused with the lunula; an interantennal frontal carina separates the two antennae; the thorax is much flattened, with a deeply emarginate anterior prescutal margin and strongly projecting humeral callosities; the notopleuron is often partly or

wholly fused with the prescutum; the prosternum is deeply divided into two lobes; the tarsal claws are bifid; the median dorsal sclerites of the abdomen are reduced or lacking. Some of the species are polyxenous, but others are among the most narrowly specific flies known.

I recognized in the subfamily Ornithomyiinae 4 subgroups on the basis of closer relationship, and gave one of these tribal rank. Three of the subgroups comprise too few genera or species, differing only in minor details, to show definite evolutionary trends. In the subgroup of 5 genera including *Ornithomyia,* however, certain orthogenetic changes are clearly correlated with special hosts, host-specificity being often more pronounced than usual. The series leading from the fully-winged *Ornithomyia* to the subapterous, flightless *Myiophthiria* is one of the most instructive sequences of evolutionary stages I am acquainted with among insects (J. Bequaert, 1943*a,* pp. 109–112). It is best understood by following first the gradual reduction of the wings. The common, more generalized species of *Ornithomyia,* such as *O. avicularia* and *O. fringillina,* have long, fully-developed wings, with a complete venation, and are as good fliers as any other winged hippoboscid. In the Old World group of *Ornithomyia biloba,* as well as in the American subgenus *Pseudornithomyia,* there is a decided shortening of the wing, the venation remaining normal, although the veins tend to crowd toward the anterior margin. Further reduction of the wing, eventually culminating in the functionless condition, apparently proceeds along two different lines. In one, leading to *Stenepteryx,* the wing retains its full length, but has lost most of the posterior membrane, while some of the veins disappear and the remainder crowd near the costa. In the other, leading through *Crataerina* to *Myiophthiria,* the whole wing is shortened with crowding or loss of most of the venation, until in *Myiophthiria* it is reduced to a short, broad flap, barely extending beyond the scutellum and with a few thickened rudiments of veins. All known species of the 3 subapterous genera are incapable of flight. Moreover, the reduction of the wings is accompanied by other changes affecting nearly all parts of the body. The most striking of these are: the lengthening of the head; the reduction of the compound eyes; the atrophy or loss of ocelli; the extreme development of the humeral callosities; the obsolescence of the dorsal thoracic sutures; the gradual disappearance of most of the tergal sclerites of the abdomen; the unusual development of the legs, particularly of the deeply cleft claws; and the increased pilosity. It is of interest that

these changes progressed farther in some species than in others. The American *Crataerina seguyi* is clearly less evolved than its Old World congener, *C. pallida,* and hence easier to recognize as a modified *Ornithomyia* of the *biloba* type. On the other hand, as pointed out before (J. Bequaert, 1943*a*, p. 109), the Old World species of *Myiophthiria* are slightly more specialized than the American, so that there is some reason to retain the subgenus *Brachypteromyia* for the New World forms.

The choice of a restricted and peculiar type of host was, it seems, the main factor determining this orthogenetic evolution. The more generalized species of *Ornithomyia* of the *avicularia* group show little host-specificity, being found on a variety of passerine and game birds, even sporadically on birds of prey; but those with shortened wings of the *biloba* group use only swallows and martins (Hirundinidae) as regular breeding hosts. *Stenepteryx hirundinis* also lives normally on swallows, though straying occasionally to swifts (Apodidae). The Old World species of *Crataerina* and all species of *Myiophthiria* are restricted to swifts, at least for breeding; but the one American *Crataerina seguyi* is associated with swallows only. Evidently the ancestors of the swift-flies were swallow-flies and the shift from swallows to swifts as hosts induced the series of evolutionary changes in structure eventually culminating in *Myiophthiria.*

As in most such cases, both the original selective factor which initiated the changes and the later adaptive mechanism involved elude us as yet; but the end result may be recognized as an efficient adjustment to the special morphology and habits of the hosts. Swallows and swifts are among the most aërial of birds, with the swifts by far the speedier of the two groups. Some species of swifts are possibly the fastest birds for their size, sometimes reaching 70 to 100 miles per hour.[18] Both swallows and swifts are also capable of long-sustained flight, as they catch their food on the wing; but, again, swifts spend much longer uninterrupted periods in the air, some species being unable to perch. When not nesting, they may stay aloft at one stretch for the major part of a day. In swallows and even more so in swifts, the narrow pointed wings, very long in proportion to the small body, and the frequently forked tail (with the fork capable of opening and closing) are clearly adaptations to a predominantly aërial life. The body and

[18] These appear to be the most reliable estimates of the speed in flight of these birds (further details in J. Bequaert, 1943*a*, p. 111).

particularly the head are built so as to offer the least resistance to the air, both being perhaps more streamlined in swifts than in swallows. The plumage is very even and smooth at the surface. That of swifts is usually coarser, stiffer, with less down on the base of the body feathers, than that of swallows.[19] Several of these features fit in well with structural peculiarities of their parasitic flies. The reduced or atrophied wings decrease the risk of the fly's being blown off the host travelling at high speed. Fully-developed wings are also of no further use for reaching a new host, since the bird spends so much of its life in mid-air and away from the nest. The larvae are deposited in the nests, where the adults emerge and new hosts are usually available, at least during the breeding season. The lengthened head and more than usually flattened, nearly wingless body, as well as the strong, spider-like legs, enable the fly to glide swiftly through the dense, coarse plumage, where it can take a firm hold on the feathers with the exceptionally strong legs and the long, deeply split claws. The many long, stiff setae covering the body, legs and the costa of what remains of the wing, also help the fly to stick to the feathers like a burr. The obsolescence of the thoracic sutures is a sequel to the disuse of the wings and is of doubtful direct use to the insect. This applies also to the reduction of the compound eyes and loss of ocelli, the atrophy of the organs of sight generally following the loss of the power of flight in Diptera.

Speiser (1899*c*, p. 122; 1908*c*, p. 425; 1909*a*, p. 102) correlated the subapterous condition of *Stenepteryx*, *Crataerina* and *Myiophthiria* with the nesting habits of the swallow and swift hosts. Most of these birds build fairly permanent nests, many of them often assembled in colonies, the birds returning to the same colony and even using the same nests year after year. Two of the genera of flies (*Stenepteryx* and *Crataerina*) are known to larviposit in the nests and *Myiophthiria* probably does likewise. In temperate regions the puparia pass the winter in the empty nests after the fall migration. Upon the birds' return in the spring, newly-emerged flies, though flightless, have little difficulty in reaching the right

[19] The similar adaptive peculiarities of swifts and swallows were acquired independently, as the two groups are not related, being placed in distinct orders by modern ornithologists. It may be of some interest to us that the swifts (Apodidae) date probably from the Upper Eocene, fossil remains being known from the Oligocene to date.

host by running, either in the same or in a nearby nest. Subapterous species of bird louse-flies could scarcely survive unless the nests of their hosts were congregated, as well as fairly durable. It is also no doubt true that flies living on birds that nest in colonies no longer need wings in order to reach the host after emerging. Nevertheless, it is difficult to conceive how the host's gregarious nesting habit alone could have been a selective factor powerful enough to induce the gradual reduction of the wings, as well as the several concomitant changes in body structure mentioned above. Gregarious nesting habits of the hosts have not always been followed by their louse-flies losing the power of flight. Some of the species of *Ornithomyia* mentioned above as specific parasites of swallows have retained the wings and make full use of them. Likewise, the species of *Olfersia* associated with oceanic or marine birds, most of which nest in large colonies or permanent rookeries, are good fliers and show no tendency toward a reduction of the wings.

The evolution of *Crataerina* from an *Ornithomyia*-like bird-fly (though not from one of the Recent species) is obvious. It seems unnecessary to do much more than mention a recent suggestion (Legendre, 1952) that *Crataerina pallida* had "ancestors in the distant past parasitic of mammals" and that it "became adapted secondarily to birds." *Crataerina* could not possibly be derived from any known type of mammal-fly and it has all the essential characters of the other Ornithomyiinae of birds.[20]

3. **Evolution of Louse-flies of Mammals.** Although the bird-flies of the more specialized subfamily Ornithomyiinae are at present the dominant hippoboscid group, there is no compelling reason why this should always have been so. If the mammal-flies evolved from bird-flies, as seems most plausible, the shift from birds to mammals may have occurred on several independent occasions,

[20] The author's notion that the bristles of the head and scutellum of *C. pallida* are "ctenidia-like" or that those of the scutellum form a "true ctenidium" is based on a misapprehension of the nature of the ctenidia found in most Nycteribiidae and some Streblidae. The bristles of *Crataerina* are actually not stiffer, not more nuerous and not more slanting than in some fully-winged bird-flies or even some free-living muscoids. Those on the scutellum of *C. pallida* are ordinary bristles, unequal in length and thickness, irregulary scattered over the surface and a long way from forming a ctenidium.

each time starting from a different type of bird-fly. Only four such lineages survived to the Recent Era, mostly as a few relicts; but it seems reasonable to surmise that other similar mammal-infesting lines of descent are now extinct. Presumably the mammal-flies flourished during the Age of Mammals, which reached its peak during the Oligocene and Miocene, rapidly declining later.

The Recent mammal-flies all have simple claws and humeral callosities either not, or only moderately, projecting along the sides of the head, two primitive characters retained also by the Ornithoicinae of birds. It would appear then that their ancestors shifted to mammalian hosts fairly early in the history of the true Hippoboscidae, when the majority of the bird-flies were less specialized than the Recent Ornithomyiinae.

A consideration possibly of some evolutionary significance is the relative size of the bird-flies and mammal-flies. In the Recent fauna, the primitive Ornithoicinae of birds are very small, in fact the smallest of the louse-flies. The more specialized Ornithomyiinae of birds are all larger and include the largest hippoboscids known (*Ornithoctona*). Some of these large flies live on relatively small birds. The gradual increase in size on birds was made possible by the excellent protection offered by the feathers against destruction by the host, always the most dangerous enemy of the flies. Recent mammal-flies are medium-sized (Hippoboscinae) to small (Melophaginae), in spite of the average larger size of their hosts as compared with the majority of birds. The small size allows for better adherence and greater safety in the rather short and loose pelt of most mammalian hosts, and may have been retained by the mammal-flies from the ancestral bird-fly stocks, making it plausible that the earliest, primitive true hippoboscids were small insects.

In addition to the two primitive characters mentioned above, all mammal-flies share one specialized feature, namely the broad and flattened interantennal area of the frons, in which the lunula and frontal carina are completely or mostly fused. This peculiarity is, however, also present in *Olfersia,* a genus of bird-flies in the subfamily Ornithomyiinae, indicating that the specialized frons was possibly acquired at a later date and independently by each of the four side-branches of mammal-flies.

The early history of the mammal-flies is entirely conjectural. It can be guessed partly by considering the specializations of the Recent forms, as was done in previous paragraphs. Additional light may perhaps be thrown on it by a brief consideration of the

evolutionary history of the Class Mammalia, which, in so far as it concerns the present problem, has three outstanding features. (1) A tremendous adaptive radiation, which for number, diversity and extent of the resulting types far exceeds that of any other comparable group of animals during a similar span of time. (2) The extraordinary rapidity with which this far-reaching diversity was produced. After a rather slow start during the latter half of the Mesozoic, the mammals differentiated tremendously during the first half of the Tertiary, so that by Oligocene and Miocene times their evolution had reached its peak. (3) The even more rapid decline of the Class at the close of the Tertiary, particularly during Pleistocene and Recent times. According to Simpson (1945, p. 35), the known mammals, both living and extinct, belong to about 3000 well-defined genera, representing 32 distinct major groups (or orders), subdivided into 257 groups of lesser importance (families). Of these, however, only about 1000 genera, representing 118 families and 18 orders, survived to the Recent era. Since the knowledge of the Recent forms is nearly complete, while that of the extinct forms will always be fragmentary, the Age of Mammals is evidently long since past.

The abundance and great diversity of potential mammal hosts during mid and late Tertiary caution us not to rely too much on the present-day host-relations in attempting to trace the original hosts of the Recent mammal-flies. It can be shown, nevertheless, that the few orders of mammals to which four hippoboscid subfamilies are nowadays restricted, were well represented during the Tertiary, making it at least plausible that each subfamily could have started on hosts similar to those it now prefers or, at any rate, belonging to the same order.

This conclusion is perhaps most probable for the Melophaginae, the only subfamily with a fair number of Recent forms. It now contains 4 genera with 22 valid species, all restricted to the suborder Ruminantia (in which Simpson unites the Pecora and Tragulina) in the order Artiodactyla, and is world-wide, though more abundant in the Old World. The earliest Artiodactyla definitely recognized as such are of Lower Eocene age; but as they occur both in Europe and North America and have no known relatives in the Paleocene faunae of those regions, they must have been invaders from elsewhere. The original stock of the order was probably derived from more archaic mammals during the Cretaceous, either in Central Asia or, perhaps more probably according to Pilgrim (1941), in Central Africa. The suborder Ruminantia, which alone

concerns us here, presumably had a common ancestor in late Eocene, and flourished with a world-wide extension during the Oligocene and Miocene. Although it declined during the Pliocene, it is even now incomparably the most widespread and most differentiated group of Artiodactyla.

The early history of the Tragulina is somewhat confused, but the only Recent family, Tragulidae, has been traced as far back as the Upper Miocene in Europe and Asia; it was never very prolific and survived only in 2 genera with a few species in Africa and Asia. The scarcity and restricted areas of the Recent species no doubt explain why only one fly (*Lipoptena gracilis*) is known from the Tragulina (namely the Oriental *Tragulus*).

Of the other Melophaginae, 20 parasitize Pecora of the families Cervidae and Bovidae (Part I, pp. 287–294), the host of one (*Lipoptena grahami*) being as yet unknown. These keds are about equally divided between the two families (2 genera with 9 species on Cervidae; 3 genera with 11 species on Bovidae); but they are more numerous in the Old World (3 genera with 16 species) than in the New (2 genera with 4 species). No species is known to occur on both families. The original birthplace of the Pecora seems to have been Central Asia, probably during the Oligocene. They became a flourishing group, spreading to all parts of the world except Australia, Tasmania, New Zealand, the Pacific Islands (including Hawaii), Madagascar and the Antilles.

Primitive Cervidae are found in the Oligocene and Miocene of Central Asia, Europe and North America; but the modern types, to which the Recent genera belong, are not known from before the Pliocene in the Old World and the Pleistocene in the New. Presumably the ancestors of all the Recent American Cervidae migrated from the Old World well along in the Pliocene (Simpson, 1945, p. 268). This late arrival possibly accounts for the paucity of native American mammal-flies, the known 4 species being restricted to 3 genera of Cervidae (*Odocoileus, Mazama* and *Ozotoceras*), all of the subfamily Odocoileinae. The 5 Melophaginae of Old World Cervidae have a greater variety of hosts, being known from 6 genera in the 4 subfamilies, Moschinae (*Moschus*), Muntiacinae (*Muntiacus*), Cervinae (*Cervus* and *Axis*), and Odocoileinae (*Capreolus* and *Alces*). All the keds of Cervidae (8 *Lipoptena* and 1 *Neolipoptena*) belong to the more generalized tribe Lipoptenini.

The strictly North American Antilocapridae, or pronghorn antelopes, abundant during the Pliocene, comprise only one Recent

genus and species. The few sporadic records from the pronghorn of *Neolipoptena ferrisi*, a regular parasite of Cervidae (*Odocoileus*) are probably due to accidental straggling from deer. In any case, they are of no particular significance for the present discussion.

True Bovidae are recognized as far back as the Lower Miocene in the Old World; but in the New World they appear first in the Pleistocene, evidently following an invasion from Eurasia. In the Recent American fauna they are represented only by *Oreamnos, Ovibos* and *Ovis*, in the subfamily Caprinae, and by *Bison*, in the subfamily Bovinae. The late arrival and scarcity of Bovidae in the New World, as well as their restriction to temperate North America, probably account for the American Recent species having no known hippoboscids. All 5 subfamilies of Bovidae recognized by Simpson (see Part I, pp. 289–293) contain regular breeding hosts of Melophaginae in the Old World. The Bovinae date from the Lower Miocene, the Hippotraginae, Antilopinae and Caprinae from the Lower Pliocene, and the Cephalophinae from the Pleistocene. It seems possible therefore that the ancestors of some of the less specialized Lipoptenini passed to Bovinae during the Miocene; while the very specialized, degenerated Melophagini, now restricted to 3 genera of Caprinae (*Capra, Ovis*, and *Rupicapra*), probably developed later, perhaps during the Pliocene.

From the evidence presented in the foregoing paragraphs it seems fairly certain that the ancestral stock of all Melophaginae originated in the Old World during the Miocene, perhaps first on Cervidae, passing later to Bovidae. It migrated with Cervidae to the New World during the Pliocene, after *Lipoptena* had acquired its modern generic characters. To judge from the great reduction of the abdominal sclerites, the strictly American *Neolipoptena* is more specialized and probably evolved in the New World during the Pliocene from a *Lipoptena*-like ancestor.

The Hippoboscinae comprise 8 Old World species of *Hippobosca* (J. Bequaert, 1931, 1939*b*, and 1941*a*). The 4 species known from wild hosts are strictly African: *H. rufipes* of antelopes, also established on domesticated equines and bovines; *H. hirsuta* and *H. fulva* of antelopes; and *H. struthionis* of the ostrich. *H. camelina*, of northern Africa and southwestern Asia, occurs nowadays only on domesticated camels and dromedaries; it was presumably retained without change from wild camel ancestors. *H. equina* and *H. variegata* are more difficult to deal with, as they are found only on domestic equines and bovines, being almost equally common on

both. Their present distribution in domestication is extensive and includes some African territory; but much of it is artificial and due to the agency of Man. What the original hosts and habitat were is at present an insoluble problem (Part I, pp. 301–308). I assume tentatively that *H. equina* was a parasite of both wild equines and bovines when these animals were first domesticated, leaving open the question of its original wild host. This may have been one of the African Bovidae (Artiodactyla), from which it passed in nature to wild equines before domestication was attempted. *H. variegata* was almost certainly parasitic of one of the putative ancestors of cattle, either in Africa or in southern Asia, passing later to domestic equines. *H. longipennis,* a common fly of wild African Carnivora, spread with domestic dogs to many parts of the Old World (Part I, pp. 298–301). Almost certainly it evolved rather recently (perhaps during the Pleistocene) from *H. equina,* to which it is so close that it is sometimes regarded as at best subspecifically distinct. *H. struthionis* is specific of the African ostrich and its ancestor perhaps lived on antelopes in the same area. Ostriches are flightless, swiftly running birds, ecologically similar to antelopes, with which they associate sometimes in common herds.

The foregoing data seem to indicate that the evolution of the Hippoboscinae, like that of the Melophaginae, was closely tied up with the rise and decline of the Artiodactyla, particularly of the suborder Ruminantia. This is fairly certain for *H. rufipes, H. hirsuta, H. fulva, H. equina,* and *H. variegata;* also for *H. camelina,* as the Camelidae are the only Recent survivors of the suborder Tylopoda in the Artiodactyla. Camelidae are known in the New World as far back as the Upper Eocene; but in the Old World they appear only in the Pleistocene and apparently were never very numerous. Their early history, however, possibly has little bearing on the evolution of *Hippobosca,* as *H. camelina* may have evolved from a congener living on one of the Ruminantia. In view of their distinctiveness, it seems reasonable to assume that the Hippoboscinae once contained many more African species, chiefly parasites of Ruminantia. *H. struthionis* likewise was presumably derived from a louse-fly of Ruminantia, most probably of antelopes. The Struthionidae first appear in the Lower Pliocene of Asia and southern Europe; but in Africa they are not known with certainty before the Lower Pleistocene (Howard, 1950, p. 18). The origin of *H. struthionis* could then be dated tentatively from the Pleistocene, when the African Bovidae were seemingly at their

peak. It should be noted that all known species of *Hippobosca* are very similar and that their specific characters show no obvious adaptations to the present-day preferred hosts. This is particularly true of *H. struthionis,* which possesses no peculiarity that would seem to fit it specifically to life in plumage rather than in pelt.[21]

Allobosca crassipes, the single species of Alloboscinae, occurs only in Madagascar as a specific parasite of Lemuridae and Indriidae. These Primates of the superfamily Lemuroidea are likewise restricted to Madagascar and the Comoros in the Recent fauna (Simpson, 1945, pp. 61–62). Lemuroidea of extinct families are known from the Paleocene and Eocene of Europe and North America; but in Madagascar they have been found fossil only in Pleistocene deposits. In view of the former wide range of the superfamily, it would seem most hazardous to assume that the ancestor of *Allobosca* originated in Madagascar from a bird-fly that passed to early lemurids or indriids, though this is not impossible. Some of the specializations of the legs, frons, antennae and wings of *Allobosca* are perhaps special adaptations to life on lemurs; but too little is known of this fly to speculate upon the matter.

The Ortholfersiinae or wallaby-flies of Australia and Tasmania are the least studied of all louse-flies. Apart from their being restricted to Marsupialia of the superfamily Phalangeroidea and to the family Macropodidae, almost nothing is known of their habits. All reliable host records thus far are from members of the subfamily Macropodinae. The Macropodidae are nowadays endemic in the Australian area and they are known as fossils only from the Australian Pleistocene. That the order Marsupialia can be traced outside Australia as far back as the Upper Cretaceous has probably no bearing on the origin of the Ortholfersiinae. Being restricted to the Macropodinae, the wallaby-flies may have originated in the Australian area from bird-flies that passed to ancient wallabies. They seem to have departed less than other mammal-flies from the original bird-fly type, suggesting that they are perhaps of more recent origin. Further surmises would be futile, as the "recorded history of marsupials is very defective because of the almost complete ignorance of Tertiary Australian forms" (Simpson, 1945, p. 171).

[21] The information on the Artiodactyla used in discussing the evolution of the Melophaginae and Hippoboscinae was obtained from Simpson (1945, pp. 143–162 and 258–272).

V. Origin and Suggested Phylogeny

Throughout my discussion of hippoboscid evolution I stressed that the factual evidence is fragmentary and inconclusive, chiefly owing to the scant fossil record and the small number of Recent genera and species, clearly remnants only of a once more varied group. Nevertheless, some tentative conclusions possibly of more general interest may be drawn from the foregoing sections.

1. **Basic Hippoboscid Features.** To the student of evolution the hippoboscids appear as integral ectoparasites successfully adapted in structure, function and behavior to permanent adult life on birds or mammals, to a strict blood diet and to a very low rate of reproduction by adenotrophic viviparity. Each of these three lines of adaptation involved many structural and physiological departures from the more primitive, free-living, polyphagous and oviparous dipteran ancestors. Not the least interesting aspect of this evolutionary process is that the final product is a closely integrated harmonious whole, one of the most intricately perfect in the animal kingdom.

a. The basic structural peculiarities of all hippoboscids, namely the flattened body, wedge-shaped head, modified antennae and widened sternal area, now function as adaptations or adjustments to permanent, obligate ectoparasitism. They are, however, so universal and so uniform throughout the family, that they must be of great antiquity and possibly were acquired in some less specialized form by the hypothetical Proto-Hippoboscidae before the flies became permanently established on the hosts. It is by no means clear what circumstances determined the original trends for such far-reaching changes, eventually all coördinated toward a common goal. On the modern assumption that Natural Selection works on small mutations produced at random, there seems to be scarcely sufficient selective power in a shift from free-living conditions to permanency on a bird or a mammal.

Indeed, a comparison of the Glossinidae and Hippoboscidae makes one wonder whether permanent ectoparasitism offers decisive advantages over free life. In discussing the relationship between the two families I pointed out that they share the exclusive blood diet at all stages and the adenotrophic viviparity, but differ fundamentally in body structure. The free-living Glossinidae are only slightly more specialized higher Muscoidea. They stalk the vertebrates on which they feed and keep on the alert while engorging as quickly and as fully as possible. Their sense organs, par-

ticularly of sight and smell, are unusually keen, their flight responses rapid and their oesophageal diverticulum is filled to capacity at the end of a meal. When fully engorged, they are helpless and hide or rest while digesting. They are exposed to many hazards, to which they often succumb. The lack of permanent shelter and the need for proper temperature and humidity, especially in connection with adenotrophic viviparity, limit their present-day occurrence to the tropics. On the other hand, they can move freely among a variety of hosts and environments, retain much latitude in the choice of the food supply, and are able to withstand protracted fasting. These advantages enable them to survive on cold-blooded as well as on warm-blooded hosts and to become adapted to a wide range of ecological conditions. It is significant that, when undisturbed by Man, their populations are much larger than those of most louse-flies, in spite of a similar low rate of reproduction.

In sharp contrast, the Hippoboscidae remain in the plumage or pelt, protected against parasites, predators and adverse climatic conditions, except for brief periods when they leave the host for larviposition, as most of them do (Part I, pp. 116–120). They must, however, be constantly on guard against the host itself, their most effective enemy. As they are permanently settled on the food supply, they can afford to time and limit their meals, so that the diverticulum tends to become functionless. The microclimate of the insulated plumage or pelt offers ideal temperature and humidity for digestion and for viviparous reproduction. Although the louse-flies are essentially tropical, the sheltered environment makes them more independent of the macroclimate, so that some species extend to extra-tropical or even cold-temperate areas with their hosts. Nevertheless, there are some real, though not so obvious, disadvantages to an obligate association with a host. As I have shown in the discussion of the evolution within the family, as host-specificity becomes more restricted it tends to produce an increasing bodily and physiological adaptation to definite types of vertebrates. Much of Part I of this work was devoted to showing that, in spite of their great mobility, a fair proportion of Hippoboscidae are as narrowly host-specific as other groups of ectoparasites. The resulting specializations doom the louse-fly to extinction if its breeding host disappears, a factor no doubt chiefly responsible for the decline of the family at the close of the Tertiary. In most hippoboscids the ability to survive away from the proper host is very limited. In addition, as the majority of species either larviposit

or emerge away from the host, the offspring often fails to reach a suitable host, which explains the small fly populations on individual hosts and the low frequency of infestation most commonly observed (Part I, p. 227).

It is questionable therefore whether the advantages of permanent ectoparasitism outweigh the drawbacks, or, at any rate, have a very high survival value in competitive Natural Selection. It is reasonable to assume that the free-living direct ancestors of the Hippoboscidae first contacted vertebrate hosts for purely trophic reasons, similar to those that attracted other types of free-living hematophagous Diptera. Even some of the latter now tend to remain on the host after feeding. Certain species of Simuliidae, or black-flies, which prefer feeding on birds, are occasionally found fully engorged, hiding in the feathers (J. Bequaert, 1938*c*, p. 118). The American and European horn-fly *Siphona irritans* (Linnaeus) (= *Lyperosia irritans; Haematobia serrata*), an oviparous, blood-sucking muscoid, remotely related to the tsetse-flies and louse-flies, remains almost permanently on cattle which it leaves only for a few minutes to oviposit (Riley and Howard, 1889; McLintock and Depner, 1954). Neither the Simuliidae of birds nor *Siphona* show a noticeable flattening of the body, spreading of the coxae, or other structural adaptations to permanent ectoparasitism. Other non-bloodsucking muscoids, such as *Carnus hemapterus* Nitzsch of Europe and North America and *Neottiophilum praeustum* Meigen of Europe, are also obligate parasites of birds in the adult instar. *Carnus* is of especial interest because the head and thorax are flatter than in its closest free-living relatives and because it loses the wings after settling on the host (J. Bequaert, 1942*b*).

I suggest that the structures now functioning as adaptations to obligate parasitism did not necessarily start in response to permanency on a host. Some, if not most, of the changes involved may have been initiated before the Proto-Hippoboscidae or the earliest true Hippoboscidae took to remaining on vertebrates. They may even date from a time when the earliest warm-blooded birds were too poorly or too incompletely feathered to offer much shelter to flies. The free-living ancestral forms may have been blood-sucking nidicoles, hiding in or near the nests or nesting sites, in cracks of rocks, beneath bark or among nesting material. The flattening of the body and concomitant changes were in this case at first adaptations to the need for shelter between feedings. Some other dipterous families, such as the Sciaridae, Cypselidae (Sphaeroceridae or Borboridae), Helomyzidae and Phoridae, contain scavengers in

nests and some of these tend to be depressed. Of course, after the presumed nidicolous ancestors of the louse-flies settled permanently on birds, selection soon enhanced the dorso-ventral flattening because of its obvious advantages on flying hosts.

b. The origin of strict hematophagy and of the adjustments it called for, is not difficult to understand (Part I, pp. 98–99). It seems unnecessary to go into the matter again.

c. In discussing the possible origin of adenotrophic viviparity or so-called pupiparity (Part I, pp. 174–175), I reached the conclusion that it has not been adequately explained thus far. I stress once more that I cannot regard it as a simple improvement upon the ovoviviparity of certain other Diptera, such as those mentioned by Hagan (1951, pp. 80–83). There are no known reproductive arrangements connecting these two types of viviparity in the Diptera. In my opinion, the gap between ordinary ovoviviparity and adenotrophic viviparity is at least as wide as that between the ovoviviparity of certain vertebrates and the placental viviparity of most mammals.

A definite correlation between strict hematophagy and adenotrophic reproduction is sometimes assumed. D.E. Hardy (1954) reported recently that *Prosthetochaeta fasciata* Grimshaw, a Hawaiian non-bloodsucking calliphorid, voids a third instar maggot which forms a puparium at once. This raises the possibility that the ancestors of the Glossinidae and Hippoboscidae could have acquired adenotrophic viviparity before they were strictly hematophagous.

The combination of an exclusive blood diet and adenotrophic viviparity results in a highly specialized type of integral parasitism most unusual among insects. The distinction between *partial* and *integral parasitism*, based on the food habits, seems to me more fundamental than any other proposed major grouping of the parasites of vertebrates. It involves not merely adaptive changes in structure and behavior, but also more difficult and far-reaching physiological adjustments of diet and metabolism. Partial parasites have a mixed diet and obtain part of the material and energy they require from a non-vertebrate source, either as adults or more often in the earlier instars. Integral parasites, with a single diet throughout life, derive all material and energy from living vertebrate tissues only.

While integral parasitism is the rule among helminth and arachnid parasites of vertebrates, it is more unusual among insects. Integral insect parasites of vertebrates are of three types. In the

simplest and most frequent type, the adult and all larval instars feed individually on living vertebrate tissue only (Anoplura, Mallophaga, blood-sucking Hemiptera). A second, relatively small group comprises the so-called bot-flies, Diptera which feed in the larval instars on vertebrate tissues only, while the adult takes no food, the mouth-parts being aborted. The so-called "pupiparous" Diptera, namely the Hippoboscidae, Nycteribiidae, Streblidae and Glossinidae, form the third and most select type, in which the adult is strictly hematophagous and the earlier instars are nurtured by the mother fly in the uterus.

2. **Origin of the Family.** It seems well-established that the Hippoboscidae are a specialized offshoot of the diversified muscoid branch of Cyclorrhapha Schizophora. It is also fairly certain that the ancestral Proto-Hippoboscidae were phyletically distinct from the ancestors of the Nycteribiidae and Streblidae. The Recent Hippoboscidae appear to be a monophyletic group directly evolved from one type of proto-hippoboscid. There are no clues from which this hypothetical proto-hippoboscid could be reconstructed. The Glossinidae appear to be the closest surviving, collateral relatives of the Hippoboscidae, but are not in the direct line of descent. Presumably both Proto-Glossinidae and Proto-Hippoboscidae arose from the same root of blood-sucking, pupiparous, free-living muscoids. One offshoot of the Proto-Hippoboscidae became an obligate ectoparasite, most probably of birds, and this branch gave rise to the true Hippoboscidae.

3. **Further Evolution in the Family.** The supra-generic divisions or subfamilies recognized in the Recent fauna are the surviving branches of the one ancestral hippoboscid stock. Other similar branches probably were produced at various times, but are now extinct. Of the original branches of bird-flies only two survived, one of them, the Ornithoicinae, retaining more primitive characters than any other subfamily. In the course of time several distinct lineages of bird-flies evolved into mammal-flies, four such phyletic lines being preserved to-day.

Each of the six subfamilies became specialized in its own way, as it tended to be more narrowly adapted to a special type of host. The tendency is most apparent in the mammal-flies, where the Melophaginae are completely, and the Hippoboscinae almost wholly, restricted to Artiodactyla, while the Alloboscinae are specific of Lemuroidea (Primates) and the Ortholfersiinae of Macropodidae (Marsupialia). Either adaptive radiation was more profuse among the Ornithomyiinae of birds and the Melophaginae of mammals

or (more probably) more of the adaptive types survived in these subfamilies. Both now contain besides fully-winged, also subapterous or apterous forms, which are interesting to compare.

It is customary to regard *Melophagus,* the most derivative of the Melophaginae, as the extreme among the specialized hippoboscids. No doubt it is superficially the most aberrant member of the family, looking more like a louse or a tick than a fly. It should be noted, however, that its evolution has been almost entirely regressive, so that it is not much more than a degenerated louse-fly. On the other hand, the subapterous *Myiophthiria,* the most aberrant of the bird-flies, is the final product of a progressive evolution, in which the successive changes resulted not so much in the loss of primitive characters as in refined and specific adjustments to a more complex environment. The fly improved considerably upon its *Ornithomyia*-like ancestor by developing a streamline, spider-like body able to move swiftly and safely among the feathers of aërial birds flying at top speed. Instead of simply losing the wings when they became superfluous or even a hazard, it modified them into short, bristly structures with a dual, tactile and retentive function.

4. **Suggested Phylogeny.** I am averse to drawing up the conventional phyletic outline or "genealogical tree" for any group of animals and particularly so for the Hippoboscidae. Only too often such a graphic presentation, which can at best be only hypothetical, confuses the reader and even its author into mistaking speculation for fact. Even with the best of care, it is scarcely possible to distinguish clearly in such an outline between actual observations, which can be controlled, and interpolated surmises, which cannot. For these reasons I shall only summarize the facts and assumptions presented in the foregoing pages, in what I conceive to be the broad lines of the past evolution of the louse-flies.

Speiser (1908*c*, pp. 440–446) made, so far as I know, the only previous attempt at a phylogeny of these insects, for which he drew up two genealogical schemes, one for the genera and the other for the subfamilies. Some of his suggestions are most valuable and I have mentioned them in my own work. His supra-generic classification (p. 445) differs, however, in many respects from my own. Although he pointed out the primitiveness of *Ornithoica,* he failed to give it proper recognition. He also overlooked the isolated position of the Ortholfersiinae, which he merged in his unnatural group Olfersiinae. His genealogy of the genera (p. 442) is based on the premise that Recent genera evolved from other Recent genera, a point of view with which I disagree. Moreover, some of the de-

tails of his scheme are most improbable. *Ornithophila,* which he derives from the *Ornithomyia* stock, is only *Lynchia* with preserved ocelli. *Stilbometopa* is more closely related to *Ornithoctona* than to *Crataerina* or *Myiophthiria,* near which he places it. *Myiophthiria, Crataerina* and *Stenepteryx* have many features in common and should have been grouped together.[22]

If it is agreed that the Glossinidae and the Hippoboscidae had most probably as common ancestor a primitive type of free-living, blood-sucking, pupiparous muscoid, this ancestral stock must have been extremely ancient. It may have appeared in the early Mesozoic, developing in association with terrestrial vertebrates even before the earliest birds evolved. Some time during the Cretaceous, when the birds were differentiating actively, the stage was set for the separation between the Proto-Glossinidae and the Proto-Hippoboscidae. The latter were at first closely associated with the nesting sites of the birds, on which they fed temporarily. The need for hiding places between meals resulted in a tendency toward flattening the body. This trend became more pronounced, particularly on the head and the sternum, as the association with birds became more permanent. It had a decided selective value when the flies were induced to take advatage of the shelter offered by the plumage. In view of the positive fact that the one known fossil hippoboscid of the Oligocene is as typical and as specialized as most Recent bird-flies, the primitive true hippoboscids must be considerably older. Possibly they evolved during the Paleocene or early Eocene, as moderately flattened, obligate ectoparasites, with simple claws, a straight anterior thoracic margin, large abdominal sclerites, and fully-developed wings with a venation perhaps even more complete than that of *Ornithoica* or *Ornithomyia.*

The Oligocene bird-fly belongs definitely to the Recent subfamily Ornithomyiinae (with split claws and prominent humeral callosities) and to the recent genus *Lynchia* (with reduced wing venation and reduced abdominal sclerites). It was therefore a fairly specialized fly. On the other hand, all Recent mammal-flies have retained the primitive simple claws and most of them lack prominent humeral callosities. It seems therefore reasonable to assume that the splitting of the original hippoboscid stock into several

[22] In using Speiser's genealogy of the genera, the reader should keep in mind that his *Olfersia* is now *Lynchia;* his *Lynchia* now *Pseudolynchia,* and his *Pseudolfersia* now *Olfersia;* his *Icosta* is now united with *Lynchia.*

branches (subfamilies, tribes and genera) occurred during the latter half of the Eocene. In particular, the shift from birds to mammals most probably occurred during the Eocene, when the evolution of mammals was most active.

Although the fossil record can never be more than fragmentary, that of the mammals is much more complete than that of almost all other animals. In the groups of mammals where it is best known, the genealogy often appears as a repeated and intricate splitting, resembling a bush rather than a tree. The Recent forms then represent the last surviving twigs on some of the side branches, other branches having become extinct before the Recent era. (See for instance, Simpson, 1953, p. 260, for the genealogy of the Equidae). Where so much of the evolution of the Hippoboscidae ran parallel with that of the mammals, it seems logical to assume that the unknown genealogy of these flies was of the same "bushy" type. Probably about the middle of the Eocene, the primitive, bird-inhabiting hippoboscids produced several more or less specialized branches, some remaining on birds, others shifting to mammals. By the early Oligocene, the Recent subfamilies and genera were all in existence, essentially as we know them to-day. Several, perhaps many, other similar branches appeared, but did not survive. As there are no Eocene fossils from which any of the immediate ancestors of the Recent hippoboscids could be surmised, it seems utterly futile to search for more definite relationships between the few surviving Recent genera and supra-generic groups.

Revision of American Genera and Species

Excluded Genera. The following genera, listed sometimes from the New World, are neither autochthonous there nor well-established introductions by Man.

Hippobosca Linnaeus (1758). There is no real evidence that this Old World genus ever became naturalized in the New World on either a domestic or a wild host. *H. equina* Linnaeus, a common parasite of cattle and horses (Part I, p. 304), was mentioned by W. Kirby (1837, *Fauna Boreali-Americana*, **4**, p. 317; reprinted by Bethune, 1881, *Canad. Entom.*, **13**, p. 169), with a rather fanciful description, but without definite locality.[23] Linnaeus (1758,

[23] Kirby says, for instance: "One of the characters assigned to this genus by Fabricius is the want of stemmata, but if the present species is examined under a powerful magnifier, one will be discovered at the posterior internal angle of each eye." No species of *Hippobosca* has even traces of ocelli. Kirby must have seen the pits left by the vertical bristles, after these were broken.

1, p. 607) originally gave both Europe and North America as the habitat of his *H. equina,* but this can scarcely be used as evidence that the fly occurred in the New World at his time. Fabricius (1775, *Syst. Ent.,* p. 803; 1805, *Syst. Antliat.,* p. 337) merely repeated Linnaeus. H. Loew (1864, *Amer. Jl. Sci.,* (2), **37**, p. 518) included the fly in his list of Diptera common to North America and Europe, no doubt on Linnaeus' and Fabricius' authority. B. D. Walsh (1864, *Proc. Ent. Soc. Philadelphia,* **3**, p. 216) and Osten Sacken (1858, p. 86; 1878, p. 214) also copied the earlier authors. None of these writers cited a definite American locality. Asa Fitch (1850, p. 797) first cast doubt on the supposed occurrence of *H. equina* in North America.[24] Although Aldrich (1905, p. 653) made a similar statement, Speiser (1907*b*, p. 103; 1908*c*, p. 303) listed it again as a North American hippoboscid. Dr. F.C. Bishopp informs me (*in litt.,* 1945) that, in his long experience with parasitic Diptera of domestic animals, he never saw a *H. equina* taken in North America. The only American *equina* I have seen myself was received from Dr. H. de Souza Lopes, of the Instituto Oswaldo Cruz, labelled as taken by J. Moussatali at Rio de Janeiro, in May, 1948, on a cow recently imported from Holland. Such accidental, but temporary importations must have occurred from time to time with horses or cattle.

Hippobosca variegata Megerle von Mühlfeld (1803). This species, more often called *Hippobosca maculata* Leach (1817), is common on domestic cattle and equines, and rare on camels, in the tropical and subtropical parts of the Old World (Part I, p. 305). *Hippobosca fossulata* Macquart (1843, p. 433 [p. 276 of reprint]), another synonym of *H. variegata,* was described, without mention of sex or host, from "Brazil or Chile." The type, seen at the Paris Museum in September, 1951, is a typical *H. variegata.* Speiser (1904*a*, p. 333) recognized Macquart's *H. fossulata* in a specimen at the Vienna Museum, labelled as taken in Surinam by Thorey in 1859; but later (1908*c*, p. 421) he cited it from Colombia, probably by oversight. If Macquart's and Speiser's localities are reliable, these old American specimens no doubt came from freshly-imported horses or cattle, as was the case of the Brazilian *H. equina* mentioned above. At any rate, there is no evidence that *H. variegata* is now established anywhere in tropical America. I reported (1951*b*, p. 49) a dead specimen found at Miami, Florida, July 19,

[24] Fitch wrote "I am not aware that it has ever been discovered on this side of the Atlantic."

1944, on a plane arriving from Casa Blanca, Morocco, by way of Bermuda.

I recorded (1931, p. 315) a specimen of *Hippobosca longipennis* Fabricius (= *H. capensis* v. Olfers; *H. francilloni* Leach; *H. canina* Rondani), in the Canadian National Collection, labelled "Okanagan Falls, British Columbia, May 20, 1913 (E.M. Anderson)," without indication of a host. If this fly was actually taken in British Columbia, it came probably from a dog newly arrived from the Far East, where the species is a common pest (Part I, p. 299).

Hippobosca camelina Leach (= *H. dromedarina* Rondani; *H. bactriana* Speiser) is normally a parasite of camels and dromedaries in the Old World (Part I, pp. 308–309). I mentioned in a previous section a specimen found dead on a plane arriving in New York. Another, at the U. S. National Museum, is labelled as taken July 3, 1925, at Athenia, New Jersey, on a recently imported camel.

Ornitheza Speiser (1902) is restricted to the Old World. In his "Catalogue of North American Diptera" (1905, p. 654), Aldrich included *Ornithomyia butalis* Coquillett (1899*a*, p. 346; no sex; Bering I.; on "*Butalis sibirica*" [= *Muscicapa sibirica*]). He later (1923, p. 78) transferred this fly correctly to the genus *Ornitheza*. Bering I., one of the Commander Group, lies a short distance off the east coast of Kamchatka and must be considered part of Asia. A recent study of Coquillett's type, a female at the U. S. National Museum, shows that *O. butalis* is a synonym of *Ornitheza metallica* (Schiner), widely distributed in the Old World on a variety of hosts, but unknown from the Americas (Part I, p. 324).

Melophagus is not native of the Americas; but the sheep-ked, *M. ovinus*, was introduced by Man soon after Columbus' time.

1. Subfamily Ornithoicinae

Ornithoica Rondani, 1878

Ornithoica Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 159 (monotypic for *Ornithoica beccariina* Rondani, 1878 = *Ornithomyia confluenta* Say, 1823).

Ornithoeca Mik, 1891, Wien. Entom. Zeitg., **10**, p. 250 (emendation of *Ornithoica*; same type).

Ornithocea Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 442 (error for *Ornithoica*).

Ornithocira Ferris, 1926, Sarawak Mus. Jl., **3**, pt. 3, p. 280 (in the combination *Ornithocira beccariina*; error for *Ornithoica*).

Ornithoecia Lameere, 1938, Précis de Zoologie, **5**, p. 145 (error for *Ornithoica*).

Anthoica "Rond." Coquillett, 1899, Canad. Entom., **31**, p. 335 (with characters; monotypic for *Ornithomyia confluenta* Say; error for *Ornithoica*, corrected on p. 343). Not *Anthoica* Rondani, 1861.

Generic Characters. Small, rather robust, moderately flattened, fully-winged parasites of birds, not metallic-greenish, without dull-green pigment in the haemolymph. Head (Figs. 24*F* and 25*C*) moderately depressed, transversely elliptical, nearly free from anterior margin of prescutum, which is scarcely or not covered by the occiput. Ocelli present, well developed. Eyes large, covering the sides of the face and extending partly over the under side. Upper orbit distinct. Postvertex and frons far apart; intervening mediovertex much longer than either. Upper end of inner orbit produced into a short, erect tubercle or lobe bearing the vertical bristle; this tubercle is usually flattened and difficult to see in flies mounted on slides. Occipital margin straight. Frons (Fig. 24*G*, corrected from Fig. 5*C*, where the lunula was omitted) much shorter than vertex; upper, visible portion consisting mostly of the lunula, below which a single pit is filled by the antennae; interantennal area (frontal carina) of other Hippoboscidae barely indicated by a very short upper crescent, separated from the lunula by an arched impressed line; no apical diverging arms. Antennae (Fig. 24*G*) flattened, moderately developed, slightly diverging, protruding beyond the antennal pit, which is not closed by a rim; 1st segment separated from lunula by a complete suture, setose, elongate, its inner margin touching that of its twin; 2nd segment flattened into a short appendage, broadly rounded-truncate at apex where it bears a few long, curved bristles; protruding arista of 3rd segment flattened, gradually wider and slightly spatulate apically. Palpi moderately long. Thorax (Figs. 23*A–B* and 26*A–B*) moderately depressed. Protergum very short, barely visible from above behind occiput. Humeral callosities broad but short, not appreciably produced forward, broadly rounded off anteriorly; posthumeral suture complete, curving toward anterior margin of prescutum; prothoracic spiracle medium-sized, mostly dorsal at curved edge of outer margin. Antero-median area of prescutum slanting forward, with nearly straight post-occipital margin; transverse mesonotal suture before hind third of mesonotum, broadly interrupted over median half, deep laterally; postalar callus set off by a slight groove from disk of mesoscutum; no visible median notal suture; notopleuron wedge-shaped, much narrowed anteriorly, set off by a complete, deep suture from prescutum. Dorsal portion of anepisternum wide, lathe-shaped, with broadly rounded, scarcely projecting outer hind edge. Scutellum large, about twice as wide as long, lozenge-shaped, with rounded, low anterior and posterior angles, and narrower, more triangular sides; surface even, nearly flat; scuto-scutellar suture deep. Subscutellum

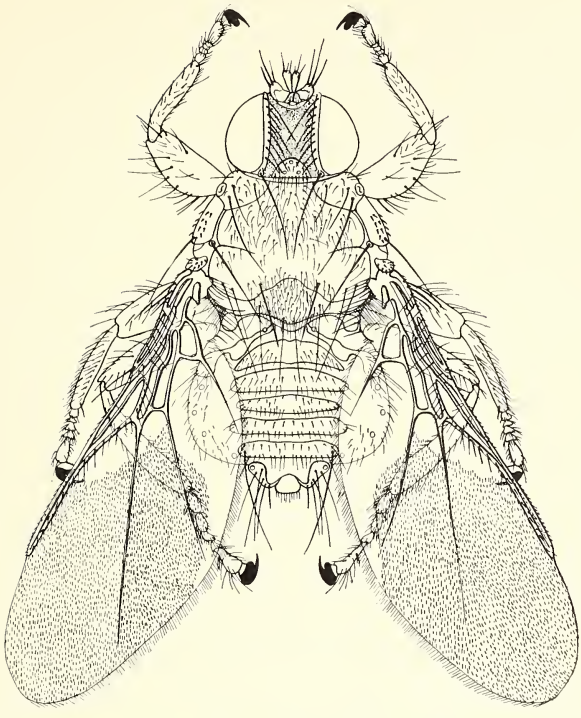

Fig. 22. *Ornithoica vicina* (Walker), ♀, Colorado Springs, on *Pica pica hudsonia*. × about 20.

narrowly visible from above behind hind angle of scutellum. Pleurotergite slightly swollen, without process. Sternum (Fig. 12*B*): pro-mesosternal suture developed only in the middle; prosternum a single, broad, trapezoidal sclerite; no sclerite in front of it in the cervical membrane; mesosternum apparently a single sclerite, with a median sternal suture over its entire length, a very slight depression without true suture setting off a triangular area near each mid coxa (? rudimentary furcasternum); metasternum undivided, consisting of a large, wedge-shaped combined basisternum and furcasternum, also divided throughout by a median sternal suture, followed by a short undivided sclerite (? spinasternum); no metasternal spur near hind coxa; pleural areas partly visible from below at sides of sternum proper. Sides of thorax more convex than usual in the family, only slightly hollowed out anteriorly for the fore femora. Metathoracic spiracle placed as in *Ornithoctona*. Legs (Fig. 23*A*)

moderately long and robust; femora slightly swollen, fore femora somewhat more so; tibiae flattened; segments of fore and mid tarsi short and broad, those of hind tarsi more elongate; hind basitarsus only slightly lengthened, without transverse row of stiff setae beneath; tips of all tibiae normal; tibial spur strong on fore and mid legs; on hind legs not differentiated from the several apical bristles. Claw (Fig. 24*E*) ending in a long, sharp, single tooth, but appearing bidentate owing to the heavy, blunt basal "heel." Wing (Figs. 24*A–B* and 25*A–B*) fully developed and functional; venation complete for the family, including three cross-veins, differing from that of *Ornithomyia* only in the peculiar 3rd longitudinal vein: this is bent upward beyond anterior cross-vein, its apical portion running close to and parallel with costa; a reclining costal spine at tip of subcosta; costa beyond this very weak or seemingly interrupted as far as apex of 1st longitudinal; subcosta complete, ending in costa; bullae in anterior basal cross-vein and in basal elbow of 4th longitudinal; costa setulose; a row of long or short setae over entire length of 1st and 3rd longitudinals on both sides of wing; membrane partly covered with microtrichia on both surfaces; alula well developed, fringed with long setae; hind margin of wing from base to tip fringed with fine, short hairs; both calypteres rudimentary. Abdomen of female (Figs. 23*A* and 26*A*) dorsally with 5 large, transverse median sclerites, the 5th sometimes contracted medially; median tergites covering most of the dorsum in newly-emerged, unfed, non-gravid flies, but disconnected by membranous areas when the abdomen is distended; two basal laterotergites, one on each side, often more or less fused with the basal median tergite, and followed on each side by a second, smaller and usually less sclerotized laterotergite; apically on each side a small sclerite, partly dorsal, partly ventral; ventrally a basal, elliptical median sternite and a median pair of small, setigerous preäpical plates. In the male (Figs. 23*B* and 26*B*), the arrangement of the sclerites is much the same; but there are only four complete median tergites, usually larger than those of the female, followed by a pair of apical sclerites sometimes joined medially, and the ventral preäpical plates are very small. Seven pairs of abdominal spiracles, placed somewhat differently in both sexes, as shown in Figs. 23*A–B*. Male terminalia very simplified: gonocoxites (paralobes) nearly aborted, reduced to two minute, soft protuberances (even more reduced than in *Ornithomyia*) bearing 2 short setae, placed some distance from the sides of the horseshoe-shaped sclerite; penis valves (parameres) sharply pointed, straight; penis rod-like, very slender apically. Body rather densely setose, particularly on the thorax. On head, orbital

bristles few, in one or more irregular rows; postvertex with several short setae, irregularly scattered; one long vertical bristle on each side on a raised lobe; 4 long bristles (2 anterior, 2 posterior) on each of the lateral sclerites of gula. On thorax, disk of mesonotum and scutellum mostly covered with many short, soft setae; the setae very short and spiniform on humeral callosity and anepisternum; in addition: 3 or 4 humerals, 2 very long; 1 very long posterior notopleural, the notopleuron otherwise bare; 1 very long mesopleural at outer hind edge of anepisternum; 2 or 3 postalars; 1 posterior dorso-central, close to scuto-scutellar suture; usually 2 pairs of very long preäpical scutellars, one medially, the other in outer corners, occasionally a third shorter bristle between them on one or on both sides. Sternum with many scattered short setae and sometimes a few longer bristles on meso-basisternum; prosternum bare; metathoracic pleurotergite with a prominent, subvertical, dense row of long bristles. Abdomen dorsally mostly bare on the soft areas, except at the sides which have a few short setae on thickened bases; basal median tergites with many scattered short setae; succeeding tergites with fewer short setae, mostly in an irregular preäpical row, some of the lateral setae longer, particularly on 5th tergite; apical sclerites with 4 or 5 very long bristles. Ventrally, female with conspicuous short, spine-like or hook-like setae on strong, knob-like swellings, the number and arrangement differing in the several species, and in addition with a few short, soft setae more or less in transverse rows and some longer bristles on the apical sclerites; venter of male usually with only normal, long setae, but with setigerous tubercles in *O. unicolor* Speiser and *O. philippinensis* Ferris, both of the Old World. Legs moderately bristly; hind trochanters with only soft setae in female (Fig. 24*C*), in addition with short, spine-like bristles near the outer hind margin in male (Fig. 24*D*).

Ornithoica is cosmopolitan throughout the tropics and subtropics. It occurs on a variety of birds, mainly Passeriformes, Strigiformes and Ciconiiformes, most species showing little host specificity. In Europe, *O. turdi* has been taken as far north as 46° N., and in America, *O. vicina* extends to 50° N. The genus contains few species, the exact number being uncertain, but probably 6 or 7. Of the 2 American species, *O. confluenta* is native in the Old World also, while *O. vicina* is possibly indentical with the Old World *O. turdi.*

Key to American Species of *Ornithoica*

1. Wing membrane with microtrichia on upper and under sides over apical two-thirds to three-fourths, including more than apical half of 3rd posterior cell, extreme tip of axillary cell,

and narrow area of 2nd basal cell. Interocular face at mid-height as wide as or slightly narrower than an eye in both sexes. Abdomen of female dorsally with a lateral patch of long setae close to and basad of the paired preäpical tergal plates ..... *O. confluenta*

Wing membrane with microtrichia on upper and under sides over slightly more than apical half, including a narrow anterior patch in apical fourth to third of 3rd posterior cell (axillary and 2nd basal cells entirely bare). Interocular face at mid-height wider than an eye in female, about as wide as an eye or slightly wider in male. Abdomen of female with very few, short dorso-lateral setae close to the paired preäpical tergal plates ..... *O. vicina*

Ornithoica vicina (Walker)

Figs. 5*C*, 12*B*, 22, 23*A–G*, and 24*A–G*

Ornithomyia vicina Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1144 (no sex. Jamaica: on *"Ephialtes grammicus"* [*Pseudoscops grammicus*]. Type ♂ at Brit. Mus.). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Johnson, 1894, Proc. Ac. Nat. Sci. Philadelphia, p. 281. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 190 (copy of original description).

Ornithoica vicina Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 263 (type. Also Jamaica: on *Amazona* [*"Psittacus"*] *l. leucocephala*). Ferris, 1929, Canad. Entom., **61**, p. 285. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, p. 327; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, No. 11, p. 289; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 83; 1943, Jl. of Parasitology, **29**, p. 131. Stuardo 1946, Catálogo Dípteros Chile, p. 187. Bartlett, 1947, The Auk, **44**, p. 457 (Massachusetts: Amherst, on *Otus asio naevius*). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, No. 4, p. 394, fig. 236 (Wisconsin: Fox River, Tichigan Marsh, Racine Co., on *Butorides v. virescens;* Cedarburg Swamp, Ozaukee Co., on *Troglodytes aëdon parkmanii;* Dodge Co., off *Turdus m. migratorius.* Illinois: Waukegan, on *Zonotrichia albicollis;* Urbana, on *Buteo jamaicensis borealis*). Alicata, 1948, Rep. Univ. Hawaii Agric. Expt. Sta. for 1946–1948, p. 104 (Hawaii: Honolulu, Oahu I., on *Passer d. domesticus*). Thompson, 1949, Ent. Mo. Mag., **85**, p. 248 (Jamaica: Corn Puss Gap, St. Thomas, on *Amazona collaris*). Wray, 1950, Insects North Carolina, 2nd Suppl., p. 33. J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, pt. 1, (for 1950), p. 9. Campbell and Lee, 1953, Studies on Quail Malaria, New Mexico Dept. Fish Game, pp. 52 and 70 (New Mexico: Las Cruces, on *Lophortyx g. gambelii*); 1953, Completion Report, New Mexico Project W-41-R, p. 3.

Ornithoctona vicina Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654.

Ornithoctena vicina Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull. **4**, pts. 1–2, p. 89.

Ornithomyia sp. near *confluens* Osten Sacken, 1878, Smithson. Misc. Coll., No. **207**, p. 263 (California: San José, on "*Accipiter fuscus*").[25]

Ornithoica confluens Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655 (in part); 1923, Insecutor Inscitiae Menstruus, **11**, p. 79 (Cuba: Santiago de Cuba. California: Ontario, on *Cinclus mexicanus*.[25] Colorado: Hotchkiss, on hawk and owl). E. P. Reed, 1932, Rev. Chilena Hist. Nat., **35**, (for 1931), p. 103 (Chile: near Valparaiso). Peters, 1933, Bird-Banding, **4**, pp. 71, 72, 73, 74, and 75 (New Hampshire: East Westmoreland, on *Dryobates pubescens medianus, Sitta c. carolinensis, Dendroica coronata, Seiurus n. noveboracensis, Spizella p. passerina, Melospiza l. lincolnii, Melospiza g. georgiana*, and *Melospiza m. melodia;* Peterboro, on *Molothrus a. ater, Junco h. hyemalis, Spizella p. passerina*, and *Melospiza m. melodia*. Massachusetts: Oak Bluffs, on *Penthestes a. atricapillus, Quiscalus q. quiscula, Molothrus a. ater, Pipilo e. erythrophthalmus*, and *Melospiza m. melodia;* Groton, on *Turdus m. migratorius* and *Melospiza m. melodia;* Worcester, on *Hylocichla f. fuscescens* and *Melospiza m. melodia*. New York: Mohawk Lake, on *Turdus m. migratorius* and *Melospiza l. lincolnii;* Elmhurst, Long Island, on *Pipilo e. erythrophthalmus, Junco h. hyemalis, Spizella p. passerina*, and *Zonotrichia albicollis*. Maryland: Silver Spring, on *Cyanocitta c. cristata* and *Junco h. hyemalis*. South Carolina: Summerville, on *Corthylio c. calendula, Mniotilta varia*, and *Pipilo erythrophthalmus alleni*. Ohio: Columbus, on *Passerculus sandwichensis savanna;* Gates Mills, on *Spizella p. pusilla* and *Melospiza m. melodia;* Leetonia, on *Spizella p. pusilla* and *Melospiza m. melodia*). Brimley, 1942, Supplement to Insects North Carolina, p. 29 (North Carolina: Raleigh, on *Accipiter cooperii*). Not of Say, 1823.

Ornithoica confluenta Speiser, 1902, Termész. Füzetek, **25**, p. 334 (new description. Brazil: Rio Grande do Sul); 1907, Ent. News, **18**, p. 103 (in part). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 187, 188 and 195; Pl. 28, fig. 9 (Brazil: on "*Ramphastos ariel*" [*Ramphastos vitellinus ariel*], *Cyanocorax c. chrysops, Troglodytes "musculus wiedi"* [*T. m. musculus*], and *Pitangus sulphuratus maximiliani*). Johnson, 1922, Psyche, **29**, p. 80, fig. 1, left hand fig. (Maine: Wilson's Mills, Oxford Co., on *Perisoreus c. canadensis*. California: San José, on "*Accipiter fuscus.*" Cuba). Champlain and Knull, 1923, Ent. News, **34**, p. 215 (Pennsylvania: Wellsboro, on *Strix v. varia*). Johnson, 1925, Bull. Northeastern Bird-Banding Assoc., **1**, p. 52; 1925, Occ. Papers Boston Soc. Nat. Hist., **7**, p. 293 (New Hampshire: Peterboro, on *Melospiza m. melodia*. Massachusetts: Braintree, on *Corvus b. brachyrhynchos*). Essig, 1926, Insects Western North America, p. 623, fig. 501. Johnson, 1927, Bull. Boston Soc. Nat. Hist., No. **42**, p. 15 (Massachusetts: Wenham, on *Bubo v. virginianus*). Johannsen, 1928, in Leonard, Cornell Univ. Agric. Expt. Sta., Mem. **101**, (for 1926), p. 868 (New York: Albany, on *Strix v. varia*). Ferris, 1928, Ent. News, **29**, p. 139 (California: Pasadena, infested with mites, *Myialges anchora*). Bau, 1929, Zentralbl. Bakt. Parasit., Abt. 2, **79**, pp. 247 and 248 (in part), fig. 2. Johnson, 1929, Bull. Northeastern Bird-Banding Assoc., **5**, p. 51 (Massachusetts: Rock, on *Spizella p. passerina;* Wellesley, on *Hedymeles ludovicianus*. New York: Cold Spring Harbor, on *Aegolius a. acadicus*). Ferris, 1929, Canad. Entom., **61**, p. 282, figs. 2*B, C, E*, 3*A-B*, and 4*B* (♀ ♂. Massachusetts: Wenham, on *Bubo v. virginianus;* Rock, on

[25] The true identity of Osten Sacken's "*Accipiter fuscus*" can not be determined. Aldrich's "*Cypselus mexicanus*" was an oversight for *Cinclus mexicanus*.

Melospiza m. melodia. California: Bluff Lake, San Bernardino Mts., on *Junco oreganus thurberi*); 1930, Canad. Entom., **62**, p. 70 (Panama: Camp Pital, Chiriqui Prov., on *Ramphastos swainsonii*). Johnson, 1930, Publ. Nantucket M. Mitchell Assoc., **3**, No. 2, p. 158 (in Nantucket list, but not actually taken there). J. Bequaert, 1933, Rev. Chilena Hist. Nat., **37**, p. 165. Dunn, 1934, Psyche, **41**, p. 175 (Panama record of Ferris, 1930). Peters, 1936, Bird-Banding, **7**, pp. 18, 19, 20, 21, 22, 23, 24, 25, 26, and 27 (New Hampshire: on the hosts listed in 1933 and on *Hylocichla guttata faxoni* and *Geothlypis trichas brachidactyla.* Vermont: on *Passerculus sandwichensis savanna* and *Melospiza m. melodia.* Massachusetts: on the hosts listed in 1933 and on *Mniotilta varia, Quiscalus quiscula aeneus, Cyanocitta c. cristata,* and *Spizella p. passerina.* Connecticut: on *Melospira m. melodia.* New York: on the hosts listed in 1933 and on *Regulus s. satrapa* and *Corthylio c. calendula.* Maryland: on the hosts listed in 1933 and on *Regulus s. satrapa* and *Wilsonia citrina.* South Carolina: on the host listed in 1933 and on *Otus asio naevius* and *Pipilo erythrophthalmus canaster.* Ohio: on the hosts listed in 1933). Herman, 1937, *Op. cit.*, **8**, pp. 162 and 165 (New Hampshire: Peterboro, on *Melospiza m. melodia* and *Zonotrichia albicollis.* Massachusetts: North Eastham, on *Tyrannus tyrannus, Dumetella carolinensis, Dendroica p. pinus, Geothlypis trichas brachidactyla, Agelaius p. phoeniceus, Molothrus a. ater, Pipilo e. erythrophthalmus, Passerculus sandwichensis savanna, Ammodramus savannarum australis, Pooecetes g. gramineus, Spizella p. passerina, Spizella p. pusilla, Melospiza g. georgiana,* and *Melospira m. melodia.*[26] Infestation with mites). Spencer, 1938, Proc. Ent. Soc. British Columbia, No. **34**, p. 44 (British Columbia: on *Melospiza melodia morphna* and *Cyanocitta s. stelleri*). Procter, 1938, Biol. Surv. Mt. Desert, **6**, Insect Fauna, p. 378 (Maine: Mt. Desert, on *Passer d. domesticus*). J. Bequaert, 1939, Science, **89**, p. 268. Essig, 1942, College Entomology, p. 814. Augustson, 1942, Bull. So. California Ac. Sci., **40**, (for 1941), p. 148 (California: Mono Lake, on *Asio wilsonianus*). Clay and Meinertzhagen, 1943, Parasitology, **35**, p. 12 (California: on *Aphelocoma c. californica* and *Pipilo maculatus megalonyx,* each with a Mallophagan, *Brüelia* sp., attached). Herman, 1945, California Fish Game, **31**, p. 23, figs. 10*B* [mislabelled *Lynchia hirsuta*] and 11*C*. Procter, 1946, Biol. Surv. Mt. Desert, **7**, Insect Fauna, p. 437 (Maine: Mt. Desert, on *Passer d. domesticus* and *Turdus m. migratorius*). Not of Say, 1823.

Ornithoeca confluenta Speiser, 1908 Zeitschr. Wiss. Insektenbiol., **4**, pp. 203, and 304 (in part).

Ornithoica promiscua Ferris and Cole, 1922 (June 14), Parasitology, **14**, p. 203, figs. 19 and 20*A–B* (♀. California: Castle Hot Springs, Lake Co., on *Pipilo fuscus carolae,* holotype at California Academy of Sciences, San Francisco; San Francisco, paratype on *Passerella iliaca* subsp.; Pacific Grove, paratype on *Corthylio calendula cineraceus;* King's River, paratype on *Falco s. sparverius.* Two flies, without locality, on *Hylocichla u. ustulata.* Paratypes at Stanford University, Palo Alto, California). Ferris, 1924, Ent. News, **35**, p. 235. Essig, 1926, Insects Western North America, p. 621. Ferris, 1927, Canad. Entom., **59**, p. 251 (California: Bluff Lake, San Bernardino Mts., on *Junco oreganus thurberi;* Altadena, on *Zonotrichia coronata* and *Pipilo maculatus* subsp. [=*Pipilo maculatus megalonyx*]; Stanford University, on *Zonotrichia coronata;* Pasadena,

[26] The North Eastham record from *Zenaidura macroura carolinensis* is here deleted, as suggested by Dr. Herman (see Part I, p. 215). It was repeated by Huff (1939, Jl. Amer. Vet. Med. Assoc., **94**, p. 619).

on *Passer d. domesticus, Aphelocoma c. californica,* and *Pipilo maculatus montanus*).

Ornithoica melaleuca Bau, 1922 (October 2), Centralbl. Bakt. Parasit., Abt. 2, **57**, pp. 276 and 278 (♀. Cuba: Estacion Meyer, Sa. Clara Province, on "large white owl," surmised by Bau to have been "*Strix flammea furcata*" [*Tyto alba furcata*]. Type presumably at Berlin Museum).

Ornithoica confluenta var. *melaleuca* Bau, 1929, Zentralbl. Bakt. Parasit., Abt. 2, **79**, pp. 247 and 248.

Ornithoica species? Bryan, 1921, Proc. Hawaiian Ent. Soc., **4**, p. 454 (Hawaiian Is.: Kauai, on pheasant); 1934, *Op. cit.*, **8**, pp. 444 and 458. Fullaway, 1932, *Op. cit.*, **8**, p. 6. G. B. Thompson, 1938, Ent. Mo. Mag., **74**, p. 49.

Distribution and Specimens Examined. Dominion of Canada. British Columbia (recorded by Spencer, 1938): Campbell River, Vancouver I., on *Dendragapus obscurus fuliginosus* (C.D. Fowle; the unnamed flies mentioned by Fowle, 1946); Quinsam Lake, Vancouver I., on *Regulus satrapa olivaceus* (J.S.F. Bendell); Duncan, Vancouver I., Oct., on *Junco o. oreganus;* Saanich, on *Aegolius a. acadicus* (G.A.N.); Departure Bay, Nonaimo, 42 specimens on *Otus asio kennicottii* (H.D. Fisher); Cowichan Lake Forest Station, Vancouver I., on *Cyanocitta s. stelleri* (R. Radcliffe); Vancouver, on *Melospiza melodia morphna* (R.A. Cumming) and *Cyanocitta s. stelleri* (G.J. Spencer).—Ontario: Toronto, on *Aegolius a. acadicus, Zonotrichia albicollis,* and *Junco h. hyemalis;* Lake of Two Rivers, Algonquin Park, on *Melospiza m. melodia* and *Quiscalus quiscula aeneus* (D.M. Davies); Lake Sasajewan, Algonquin Park, on *Melospiza m. melodia* (D.M. Davies); Ottawa, on *Turdus m. migratorius* (J. Fletcher); Arden, Frontenac Co., on *Strix v. varia* (R.O. Lindsay).—Quebec: Joliette, on *Asio f. flammeus* (J. Ouellet); St. Anne's, on *Molothrus a. ater* (W.E. Whitehead); Montreal, on *Bubo v. virginianus,* Jan. 3, (Frère Adrien Robert); Rosemont, Montreal, on *Buteo p. platypterus,* Aug. 26 (Frère Adrien Robert).

United States. Arizona: without more precise locality, 14 flies on *Junco phaeonotus dorsalis* (H.H. Kimball); Williams, Coconino Co., on *Pipilo maculatus montanus* (A.R. Phillips); Phoenix, Maricopa Co., on *Lophortyx g. gambelii* (C. Stannard); Flagstaff, Coconino Co., on *Junco phaeonotus dorsalis, Bubo virginianus pallescens, Piranga flava hepatica, Aphelocoma californica woodhouseii,* and 2 *Turdus migratorius propinquus* (A.R. Phillips); Hualpai Mts., Mohave Co., on *Strix occidentalis lucida* and *Aphelocoma californica woodhouseii* (A.R. Phillips); Sa. Catalina Mts., Pima Co, on *Strix o. occidentalis* (A.R. Phillips); Carter Canyon, Sa. Catalina Mts., Pima Co., on *Troglodytes aëdon parkmanii* (A.R. Phillips). — California (recorded by Osten Sacken, 1878; Ferris and Cole, 1922; Johnson, 1922; Aldrich, 1923; Ferris, 1927, 1929;

Augustson, 1942; Clay and Meinertzhagen, 1943; Herman, 1945): without precise locality, on *Hylocichla u. ustulata;* Castle Hot Springs, Lake Co., on *Pipilo fuscus carolae* (holotype of *O. promiscua.* — J. Maillard); Woodacre, Marin Co., on *Zonotrichia coronata;* Mono Lake, Mono Co., on *Asio wilsonianus* (R.I. Rutherford); San Mateo Mts., San Mateo Co., on *Strix o. occidentalis* (A.K. Fisher); Berkeley, Alameda Co., on *Passerella iliaca* subsp., Dec. 21, and *Pipilo maculatus falcifer* (H.E. Childs, Jr.), on *Aphelocoma c. californica,* Oct. 20 (S.K. Carnie), and on *Melospiza melodia gouldii, Chamaea fasciata phaea* and *Zonotrichia leucophrys nuttalli* (O.E. Sousa); San José, Sa. Clara Co., on *"Accipiter fuscus"* (W. Holden. — In Osten Sacken Coll. at M.C.Z.); Stanford University, Palo Alto, Sa. Clara Co., on *Zonotrichia coronata* and *Otus asio bendirei;* Strawberry, Tuolumne Co., on *Junco oreganus thurberi,* Sept. 16 (W. Jameson); Hastings Reservation near Jamesburg, Monterey Co., on *Pipilo fuscus crissalis* and *Bubo virginianus pacificus* (J.M. Linsdale); Pacific Grove, Monterey Co., on *Corthylio calendula cineraceus* (paratype of *O. promiscua*); Ventura, Ventura Co., on *Buteo jamaicensis calurus,* July 8 (J.M. Robertson); Los Angeles, Los Angeles Co., on *Melospiza melodia cooperi* (P. Stoddard); Altadena, Los Angeles Co., on *Pipilo maculatus megalonyx* (with Mallophagan attached), *Zonotrichia coronata* and *Cyanocitta s. stelleri* (J.E. Law); Pasadena, Los Angeles Co., on *Mimus polyglottos leucopterus, Molothrus ater obscurus, Euphagus cyanocephalus,* and *Melospiza melodia cooperi* (Josephine Michener), *Carpodacus mexicanus frontalis* (S.F. Wood and Josephine Michener), *Aphelocoma c. californica* (with Mallophagan attached), *Pipilo maculatus montanus,* and *Passer d. domesticus* (H. Michener); Monrovia, Los Angeles Co., on *Tyto alba pratincola* (I. Wilson); Sa. Monica Mts., Westwood, Los Angeles Co., on *Pipilo fuscus senicula* (P. Stoddard) and on *Passerella iliaca* subsp. (H. Graham); Ontario, San Bernardino Co., on *Cinclus mexicanus unicolor,* Aug. 9 (R.E. Snodgrass); Big Bear Lake, San Bernardino Co., on *Junco* sp. (J.E. Law); Bluff Lake, San Bernardino Mts., Riverside Co., on *Junco oreganus thurberi* (J.E. Law); Idyllwild, Riverside Co., on *Cyanocitta stelleri frontalis* (C.L. Remington); King's River, Fresno Co., on *Falco s. sparverius* (paratype of *O. promiscua*). — Colorado (recorded by Aldrich, 1923): Hotchkiss, Delta Co., on hawk and owl (T.H. Cowen); Colorado Springs, El Paso Co., on *Pica pica hudsonia* and *Pipilo fuscus mesoleucus* (R.M. Stabler). — Connecticut (recorded by Peters, 1936): Milford, New Haven Co., on *Bubo v. virginianus* (R.C. Morrill); Pomfret, Windham Co., on *Hylocichla f. fuscescens,* Aug. 3; New Haven, New Haven

Co., on *Bubo v. virginianus* (R. Chamberlain). — District of Columbia: on *Aegolius a. acadicus*, Oct. 27 (H.E. Ewing); Woodridge, on *Passer d. domesticus* (E.R. Kalmback). — Illinois (recorded by MacArthur, 1948): Waukegan, Lake Co., on *Zonotrichia albicollis*, Oct. 6 (W.I. Lyon); Urbana, Champaign Co., on *Buteo jamaicensis borealis* (R. Fautin). — Kansas: Lawrence, Douglas Co., on *Passer d. domesticus* (C.H. Anderson). — Louisiana: Ponchatoula, Tangipahoa Parish, on *Dendrocopos p. pubescens*, Nov. 20 (H.D. Pratt). — Maine: (recorded by Johnson, 1922; Procter, 1938, 1946): Portland, Cumberland Co., on *Buteo jamaicensis borealis* (A.G. Johnson); Wilsons Mills, Oxford Co., on *Perisoreus c. canadensis* (W.S. Brooks); Mount Desert, Hancock Co., on *Passer d. domesticus* (A.E. Brower); Lincoln, Penobscot Co., on *Bubo v. virginianus* (W.J. Clayton). — Maryland (recorded by Peters, 1933, 1936): Beltsville, Prince Georges Co., on *Melospiza m. melodia*, July 8, and *Turdus m. migratorius*, July 23 (P.R. Smith); Laurel, Prince Georges Co., on *Regulus s. satrapa* and *Cyanocitta c. cristata* (E.B. Marshall); Rockville, Montgomery Co., on *Bubo v. virginianus* (C.R. Aschemeyer); Silver Spring, Montgomery Co., on *Passer d. domesticus* (C.M. Herman). — Massachusetts (recorded by Johnson, 1925, 1927, 1929; Ferris, 1929; Peters, 1933, 1936; Herman, 1937; Bartlett, 1947): Groton, Middlesex Co., on *Mniotilta varia, Seiurus a. aurocapillus, Cyanocitta c. cristata, Melospiza m. melodia*, Aug. 26, *Dendroica a. aestiva, Turdus m. migratorius, Icterus galbula*, and *Spizella p. passerina* (W.P. Wharton and E.A. Mason); Harvard, Worcester Co., on *Melospiza m. melodia* (J.L. Peters); Amherst, Hampshire Co., on *Otus asio naevius* (L.M. Bartlett); Rock, Plymouth Co., on *Melospiza m. melodia* (A.W. Higgins) and *Spizella p. passerina;* Cohasset, Norfolk Co., on *Melospiza m. melodia*, Aug. 2 (C.L. Whittle); North Eastham, Barnstable Co., on *Pooecetes g. gramineus, Agelaius p. phoeniceus, Melospiza m. melodia*, and *Molothrus a. ater* (C.M. Herman); Athol, Worcester Co.; Wenham, Essex Co., on *Bubo v. virginianus*, Sept. 28 (J.C. Phillips); Cotuit, Barnstable Co., on *Quiscalus quiscula aeneus* (B. Shreve); Milton, Norfolk Co., on *Quiscalus quiscula aeneus* (R.M. Hinchman); Wellesley, Norfolk Co., on *Hedymeles ludovicianus* (Mrs. H.C. Durham); Braintree, Norfolk Co., on *Corvus b. brachyrhynchos;* Chatham, Barnstable Co., on *Butorides v. virescens*, Aug. 10 (J.D. Smith);[27] Martha's Vineyard, on *Melo-*

[27] It should be emphasized that, although reported as collected on a wader, this fly, as well as the one listed from Tichigan Marsh, Wisconsin, were true *O. vicina*, not *O. confluenta*.

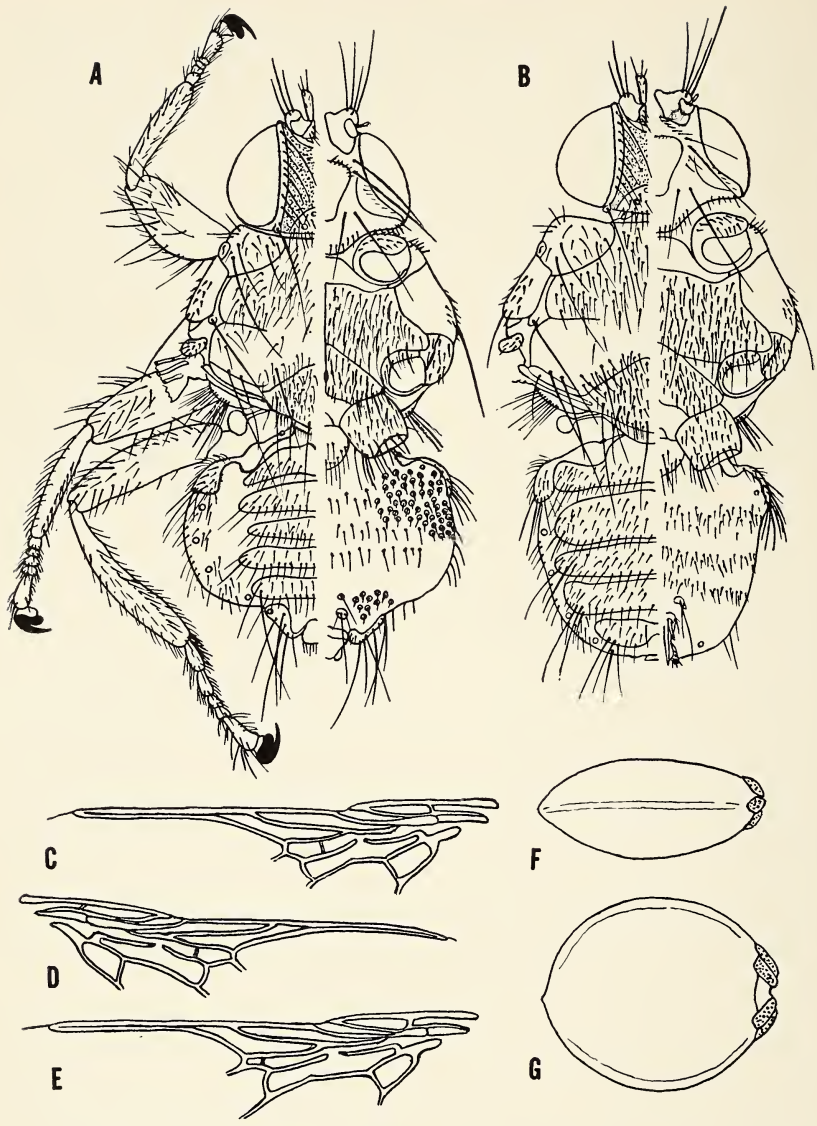

Fig. 23. *Ornithoica vicina* (Walker). **A–B**, body in dorsal and ventral view: **A**, ♀, Colorado Springs, on *Pica pica hudsonia;* **B**, ♂, Sa. Catalina Mts., on *Strix o. occidentalis.* **C–E**, abnormal venation in 3 ♀, Quinsam Lake, on *Regulus satrapa olivaceus.* **F–G**, puparium, Wenham, in ear of *Bubo v. virginianus,* from the side (**F**) and above (**G**).

spiza m. melodia, Spizella p. passerina, and *Agelaius p. phoeniceus* (G.D. Eustis); Oak Bluffs, Dukes Co., on *Cyanocitta c. cristata, Melospiza m. melodia, Pipilo e. erythrophthalmus, Quiscalus q. quiscula,* and *Penthestes a. atricapillus* (G.C. Meleney); Concord, Middlesex Co., on *Melospiza m. melodia* (W.E. Schevill). — Missouri: Columbia, Boone Co., on *Asio wilsonianus* (K.C. Rowe). — New Hampshire (recorded by Johnson, 1925; Peters, 1933, 1936; Herman, 1937): Peterboro, Hillsboro Co., on *Melospiza m. melodia, Carpodacus p. purpureus, Spizella p. passerina,* and *Junco h. hyemalis* (C.L. Whittle); East Westmoreland, Cheshire Co., on *Melospiza l. lincolnii, Melospiza m. melodia, Geothlypis trichas brachidactyla, Turdus m. migratorius, Seiurus n. noveboracensis, Dendroica coronata, Spizella p. passerina, Dendrocopos pubescens medianus,* and *Sitta c. carolinensis* (L.O. Shelley); Ashland, Grafton Co., on *Melospiza m. melodia* (Mrs. R.B. Harding). — New Jersey: Breeze Hill, Chatham, Morris Co., on *Melospiza m. melodia* (R.D. Connor); Demarest, Bergen Co., on *Toxostoma r. rufum, Cyanocitta c. cristata, Baeolophus bicolor, Turdus m. migratorius, Molothrus a. ater, Melospiza m. melodia, Pipilo e. erythrophthalmus, Dumetella carolinensis, Hedymeles ludovicianus, Icterus galbula, Piranga erythromelas,* and *Hylocichla f. fuscescens* (B.S. Bowdish). — New Mexico (recorded by Campbell and Lee, 1953): Las Cruces, Dona Ana Co., on *Lophortyx g. gambelii* (Levon Lee). — New York (recorded by Johannsen, 1928; Johnson, 1929; Peters, 1933, 1936): Orient, Long Island, on *Pipilo e. erythrophthalmus* (R. Latham); Elmhurst, Long Island, on *Regulus s. satrapa, Corthylio c. calendula, Junco h. hyemalis, Zonotrichia albicollis,* and *Hylocichla guttata faxoni* (Marie V. Beals); Cold Spring Harbor, Long Island, on *Aegolius a. acadicus* (J.M. Andrews); Rensselaerville, Albany Co. (K.W. Cooper); Ellis Hollow, Ithaca, Tompkins Co., on *Bubo v. virginianus* (C.E. Palm) and *Asio f. flammeus* (F. Harper); Caroline, Tompkins Co., on *Bonasa umbellus togata* (E.J. Gerberg); Syracuse, Onondaga Co., on *Spizella p. passerina* (R.D. Manwell); Mohonk Lake, Ulster Co., on *Melospiza l. lincolnii,* Sept. 17, and *Turdus m. migratorius,* July 11 (D. Smiley, Jr.); Greenwich, Washington Co. (A. Paladin); Albany. — North Carolina (recorded by Brimley, 1942): Raleigh, Wake Co., on *Accipiter cooperii* (Mrs. R.C. Simpson); Hoffman, Richmond Co., on *Bubo v. virginianus* (Mrs. R.C. Simpson). — Ohio (recorded by Peters, 1933, 1936): Gates Mills, Cuyahoga Co., on *Troglodytes a. aëdon,* Aug. 26, *Spizella p. passerina, Richmondena c. cardinalis,* and *Molothrus a. ater* (R. Boulton); Leetonia, Columbiana Co., on *Melospiza m. melodia* and

Spizella p. pusilla (H.S. Peters); Franklin Co., on *Asio f. flammeus,* Nov. 15 (R.M. Goslin. — The collector noted that the owl had a tree sparrow in the stomach). — Oregon: Portland, Multnomah Co., on *Melospiza l. lincolnii,* Sept. 14 (C.M. Gjullin); Coburg, Lane Co. (Oregon Agr. Coll.); Maupin, Wasco Co., on *Melospiza* sp., Oct. 24 (F.C. Bishopp); Sauvies I., Multnomah Co., on *Bubo virginianus saturatus;* Netarts, Tillamook Co., on *Corthylio calendula cineraceus,* Nov. 21, and *Chamaea fasciata phaea,* Nov. 13 (A. Walker). — Pennsylvania (recorded by Champlain and Knull, 1923): Wilkinsburg, Allegheny Co., on *Hylocichla mustelina* (H.D. Kirk); Allegheny Co., on *Asio wilsonianus* (G. Link); Mt. Lebanon, Allegheny Co., on *Bubo v. virginianus* (J. Guilday); Lester, Delaware Co. (C. Liebeck); Wellsboro, Tioga Co. — South Carolina (recorded by Peters, 1933, 1936): Summerville, Dorchester Co., on *Otus a. asio,* Sept. 26 (G.R. Lunz, Jr.), *Pipilo erythrophthalmus alleni,* Jan. 11, and *Corthylio c. calendula,* Jan. 3 (W.P. Wharton); Clemson, Oconee Co., on *Hylocichla guttata faxoni,* Nov. 15 (F.C. Bishopp). — Tennessee: Nashville, Davidson Co., on *Pipilo e. erythrophthalmus* (Mrs. A.R. Laskey). — Utah: Hooper, Weber Co. — Vermont (recorded by Peters, 1936): Barre, Washington Co., on *Cyanocitta c. cristata, Melospiza m. melodia,* and *Junco h. hyemalis* (E.M. Drew); Wells River, Orange Co., on *Passerculus sandwichensis savanna,* Sept. 4 (W.P. Smith). — Virginia: East Falls Church, Arlington Co., on *Cyanocitta c. cristata,* Nov. 26 (E.A. Chapin); Annandale, Fairfax Co., 7 flies on heads of young domestic fowl (S.L. Yoder). — Washington (State): Puyallup, Pierce Co. (C.W. Getzendauer); Seattle, King Co., on *Melospiza melodia morphna,* July 31 (Elizabeth Curt); Battle Ground, Clark Co., on *Cyanocitta s. stelleri* (J. Beer). — West Virginia: Spruce Knob, Randolph Co., on *Junco hyemalis carolinensis* (A. Wetmore). — Wisconsin (recorded by MacArthur, 1948): Poynette, Columbia Co., on *Bubo v. virginianus,* Sept. 29 (R. Rausch); Cedarburg Swamp, Ozaukee Co., on *Troglodytes aëdon parkmanii* (K.W. MacArthur); Tichigan Marsh, Fox River, Racine Co., on *Butorides v. virescens* (K.W. MacArthur); Lodi, Columbia Co., on *Bubo v. virginianus* (Frances Hamerstrom); Washburn Co., Aug. 10 (R.H. Jones).

Mexico: Cacahoatán, 600 m., State of Chiapas, on *Busarellus n. nigricollis* (Esc.N.C.Biol.); Pano Aguetle, Río Sabinas near Gomez Farias, State of Tamaulipas, on *Glaucidium brasilianum ridgwayi* (G.M. Sutton).

Guatemala: Uaxactun, Petén, on *Ramphastos s. sulfuratus* (J. Van Tyne).

Costa Rica: Turrialba, on *Turdus grayi casius* (K.W. Cooper).

Panama: (recorded by Ferris, 1930; Dunn, 1934); Chiriqui Province, on *Crypturellus soui panamensis* (L.H. Dunn); Camp Pital, Chiriqui Province, on *Ramphastos swainsonii* (L.H. Dunn).

Antilles. Cuba (recorded by Bau, 1922; Aldrich, 1923): without precise locality (E. Poey and J. Gundlach); Santiago de Cuba. — Jamaica (recorded by Walker, 1849; Austen, 1903; Thompson, 1949): without more precise locality, on *Pseudoscops grammicus* (Walker's ♂ type and another ♂) and *Amazona l. leucocephala* (P.H. Gosse.—Brit. Mus.); Corn Puss Gap, 2000 ft., St. Thomas, on *Amazona collaris* (G.B. Thompson).

Colombia: Piedecuesta, Depto. Santander Sur, on *Otus a. albogularis* (M.A. Carriker, Jr.); Cincinnati, Sa. Marta, Depto. Magdalena, on *Oreopeleia linearis infusca* (M.A. Carriker, Jr.); Chinchicuá, Sa. Marta, Dept. Magdalena, on *Thripadectes f. flammulatus* (M.A. Carriker, Jr.).

Venezuela: Colonia Tovar, State of Aragua, on *Otus* sp. [*Scops* sp.] (P. Anduze).

Brazil: (recorded by Speiser, 1902; Lutz, Neiva and da Costa Lima, 1915): Humboldt, State of Santa Catharina, on *Ramphastos dicolorus* (W. Ehrhardt); Nova Teutonia, Itá, State of Santa Catharina, on *Buteo magnirostris magniplumis, Ramphastos dicolorus, Uroleuca cristatella* (3 flies, each with a Mallophagan attached), *Micrastur ruficollis,* and *Pyroderus s. scutatus* (with a Mallophagan attached) (F. Plaumann); Cara Pintada, State of Paraná, on *Micrastur ruficollis;* Eugene Lefèvre, State of São Paulo (J. Travassos); Apuahy, State of São Paulo, on *Syndactyla r. rufosuperciliata* (G.M. Allen); Mogi das Cruzes, State of São Paulo; City of São Paulo, on *Piaya cayana macroura;* Ilha do Cardoso, State of São Paulo, on *Cyanocorax coeruleus;* Juquía, State of São Paulo, on *Buteo magnirostris magniplumis, Cyanocorax caeruleus,* and *Ramphocelus bresilius dorsalis;* Ubatuba, State of São Paulo, on *Tyrannus m. melancholicus;* Boraceia, State of São Paulo, on *Strix hylophila;* Iporanga, State of São Paulo, on *Drymophila ferruginea;* Varjão de Guaratuba, State of São Paulo, on *Hypomorphnus u. urubitinga;* Cantareira, State of São Paulo, on *Ciccaba virgata borelliana* (most of the São Paulo specimens received from the Departamento de Zoologia, São Paulo, through Dr. L. R. Guimarães).

Paraguay: Paso Yobai, on *Ramphastos t. toco* and *Colaptes campestris campestroides* (F. Schade).

Ecuador: Abitagua, 1100 m., Río Pastaza, Prov. Oriente, 2 flies on a thrush, each bearing a Mallophagan (W. Clarke-Macintyre).

Peru: Lima-Chorillos, on *Pyrocephalus rubinus obscurus* (W. Weyrauch); Hacienda Cadena, Marcapata, Cuzco, 100 m., on *Cephalopterus o. ornatus* (C. Kalinowski); Lima, on a fringillid (W. Weyrauch).

Bolivia: Incachaca, 2500 m. (J. Steinbach).

Chile (recorded by E. P. Reed, 1932; Stuardo, 1946): Concon, Valparaiso (A. Wetmore); Puerto Montt, 41° 30′ S. (A. Twoney); Valparaiso, on "zorzal," *Turdus magellanicus* (E.P. Reed); Maquehue, Temuco, on "concón," *Strix r. rufipes*, May 15.

There is a possibility that *O. vicina* may be identical with the Old World *O. turdi* (Latreille), in which case the species would be nearly cosmopolitan. Provisionally the two are here regarded as distinct.

As *O. vicina* is often overlooked, owing to its small size, its distribution is incompletely known, even in North America, in spite of the long list of localities and hosts. There are no records from Alaska, Alberta, Manitoba, Saskatchewan, New Brunswick, Nova Scotia, Rhode Island, Delaware, Georgia, Florida, Alabama, Mississippi, Arkansas, Texas, Oklahoma, Michigan, Indiana, North Dakota, South Dakota, Minnesota, Iowa, Nebraska, Montana, Wyoming, Nevada, and Idaho; although it will no doubt be found in several of these areas. The records are sporadic for the Antilles and tropical continental America, where it is nevertheless one of the most common hippoboscids. The northmost locality known is Campbell River, Vancouver I. (50° N.), and the southmost, Puerto Montt, Chile (41° 30′ S.). It has not been taken as far north as *Ornithomyia fringillina* and is also much scarcer than the latter in eastern Canada, perhaps because it is less adaptable than *O. fringillina* to short summers and severe winters (Part I, p. 122). Moreover, *O. fringillina*, the most common Nearctic bird-fly, is practically absent from the Neotropics, where *O. vicina* replaces it on passerines and certain other birds.

If *O. vicina* is regarded as specifically distinct from *O. turdi*, it is known outside the New World only from the Hawaiian Islands, where it seems to be a recent introduction by Man. Three flies and one puparium were found by E. H. Bryan in 1921 on a pheasant at Koloa, Kauai. Another specimen was taken recently in Honolulu on a domestic pigeon (Alicata, 1948). Further evidence will have to decide whether the fly is permanently established in these islands.

Known Nearctic Hosts of *O. vicina* (verified individual records in parentheses). Ciconiiformes (2): *Butorides v. virescens* (2). Falconiformes (7 and 1 undetermined hawk): *Accipiter cooperii*

(1); *A. "fuscus"* (1); *Buteo jamaicensis borealis* (2); *B. jamaicensis calurus* (1); *Buteo p. platypterus* (1); *Falco s. sparverius* (1). Galliformes (5): *Bonasa umbellus togata* (1); *Dendragapus obscurus fuliginosus* (1); **Gallus gallus bankiva* (1): *Lophortyx g. gambelii* (2). Strigiformes (33 and 1 undetermined owl): *Aegolius a. acadicus* (4); *Asio f. flammeus* (3); *A. wilsonianus* (3); *Bubo v. virginianus* (11); *B. virginianus pacificus* (1); *B. virginianus pallescens* (1); *B. virginianus saturatus* (1); *Otus a. asio* (1); *O. asio bendirei* (1); *O. asio kennicottii* (1); *O. asio naevius* (1); *Strix v. varia* (1); *S. o. occidentalis* (2); *S. occidentalis lucida* (1); *Tyto alba pratincola* (1). Piciformes (2): *Dendrocopos p. pubescens* (1); *D. pubescens medianus* (1). Passeriformes (153): *Agelaius p. phoeniceus* (2); *Ammodramus savannarum australis; Aphelocoma c. californica* (2); *A. californica woodhouseii* (2); *Baeolophus bicolor* (1); *Carpodacus mexicanus frontalis* (1); *C. p. purpureus* (1); *Chamaea fasciata phaea* (2); *Cinclus mexicanus unicolor* (1); *Corthylio c. calendula* (2); *C. calendula cineraceus* (2); *Corvus b. brachyrhynchos* (1); *Cyanocitta c. cristata* (6); *C. s. stelleri* (4); *C. stelleri frontalis* (1); *Dendroica a. aestiva* (1); *D. coronata* (1); *D. p. pinus; Dumetella carolinensis* (1); *Euphagus cyanocephalus* (1); *Geothlypis trichas brachidactyla* (1); *Hedymeles ludovicianus* (2); *Hylocichla f. fuscescens* (2); *H. guttata faxoni* (2); *H. mustelina* (1); *H. u. ustulata* (1); *Icterus galbula* (2); *Junco* sp. (1); *J. h. hyemalis* (4); *J. hyemalis carolinensis* (1); *J. o. oreganus* (1); *J. oreganus thurberi* (2); *J. phaeonotus dorsalis* (2); *Melospiza* sp. (1); *M. g. georgiana; M. l. lincolnii* (3); *M. m. melodia* (18); *M. melodia cooperi* (2); *M. melodia gouldii* (1); *M. melodia morphna* (2); *Mimus polyglottos leucopterus* (1); *Mniotilta varia* (1); *Molothrus a. ater* (4); *M. ater obscurus* (1); **Passer d. domesticus* (5); *Passerculus sandwichensis savanna* (1); *Passerella iliaca* subsp. (2); *Penthestes a. atricapillus* (1); *Perisoreus c. canadensis* (1); *Pica pica hudsonia* (1); *Pipilo e. erythrophthalmus* (4); *P. erythrophthalmus alleni* (1); *P. erythrophthalmus canaster; P. fuscus carolae* (1); *P. fuscus crissalis* (1); *P. fuscus mesoleucus* (1); *P. fuscus senicula* (1); *P. maculatus falcifer* (1); *P. maculatus megalonyx* (1); *P. maculatus montanus* (2); *Piranga erythromelas* (1); *P. flava hepatica* (1); *Pooecetes g. gramineus* (1); *Quiscalus q. quiscula* (1); *Q. quiscula aeneus* (3); *Regulus s. satrapa* (2); *R. satrapa olivaceus* (1); *Richmondena c. cardinalis* (1); *Seiurus a. auricapillus* (1); *S. n. noveboracensis* (1); *Sitta c. carolinensis* (1); *Spizella p. pusilla* (1); *S. p. passerina* (7); *Toxostoma r.*

rufum (1); *Troglodytes a. aëdon* (1); *T. aëdon parkmanii* (2); *Turdus m. migratorius* (6); *T. migratorius propinquus* (2); *Tyrannus tyrannus; Wilsonia citrina; Zonotrichia albicollis* (3); *Z. coronata* (3); *Z. leucophrys nuttalli* (1).

Known Neotropical Hosts of *O. vicina.* Tinamiformes (1): *Crypturellus soui panamensis* (1). Falconiformes (6): *Busarellus n. nigricollis* (1); *Buteo magnirostris magniplumis* (2); *Hypomorphnus u. urubitinga* (1); *Micrastur ruficollis* (2). Columbiformes (1): *Oreopeleia linearis infusca* (1). Psittaciformes (2): *Amazona collaris* (1); *A. l. leucocephala* (1). Cuculiformes (1): *Piaya cayana macroura* (1). Strigiformes (7): *Ciccaba virgata borelliana* (1); *Glaucidium brasilianum ridgwayi* (1); *Otus* sp. (1); *O. a. albogularis* (1); *Pseudoscops grammicus* (1); *Strix hylophila* (1); *S. r. rufipes* (1); *Tyto alba furcata.* Piciformes (6): *Colaptes campestris campestroides* (1); *Ramphastos dicolorus* (2); *R. s. sulfuratus* (1); *R. swainsonii* (1); *R. t. toco* (1); *R. vitellinus ariel.* Passeriformes (13 and 2 undetermined passerines): *Cephalopterus o. ornatus* (1); *Cyanocorax caeruleus* (2); *C. c. chrysops; Drymophila ferruginea* (1); *Pitangus sulphuratus maximiliani; Pyrocephalus rubinus obscurus* (1); *Pyroderus s. scutatus* (1); *Ramphocelus bresilius dorsalis* (1); *Syndactyla r. rufosuperciliata* (1); *Thripadectes f. flammulatus* (1); *Troglodytes m. musculus; Turdus grayi casius* (1); *T. magellanicus* (1); *Tyrannus m. melancholicus* (1); *Uroleuca cristatella* (1).

Bionomics. The seasonal fluctuations and host relations of *O. vicina* were discussed in part I (pp. 236–237 and 329–330). I pointed out that it agrees with *Ornithomyia fringillina* in being one of the least specific flies. The host list now comprises 113 native species (153 subspecies), 77 in the Nearctic and 36 in the Neotropical fauna. The list will be greatly extended when the ectoparasites of tropical birds are studied in earnest; but the main features of host choice will probably remain the same.

With regard to interspecific competition (Part I, p. 223), in the Nearctic Region *O. vicina* and *Ornithomyia fringillina* often infest the same species and at times even the same individual bird. Of the 77 native host species of *vicina* and 106 of *fringillina,* 59 have yielded both flies, 51 of these birds being Passeriformes. The few occurrences on the same species of Falconiformes (2), Galliformes (2), Strigiformes (3) and Piciformes (1) are obviously fortuitous, as common bird-flies will unavoidably stray from time to time to common birds. Both *vicina* and *fringillina* evidently favor some of the same passerine birds for breeding, as shown by an analysis

of the verified individual records. Of 198 native Nearctic records for *vicina,* 148 or 75 per cent are from Passeriformes, the corresponding numbers for *fringillina* being 358 and 289 or 80 per cent. These flies differ, however, decidedly in their relations to other types of hosts: *vicina* breeds also regularly on owls (Strigiformes) (34 Nearctic records, or 16 per cent), on which it is sometimes very abundant, whereas *fringillina* strays only occasionally to such birds (8 Nearctic records, or 2.1 per cent). On the other hand, *fringillina* breeds also on Galliformes (25 Nearctic records, or 7 per cent) and Piciformes (18 Nearctic records, or 5 per cent), and more doubtfully on Falconiformes (14 Nearctic records, or 4 per cent), orders on which *vicina* occurs only accidentally (4 Nearctic records, or 2 per cent, on Galliformes; 2, or 1 per cent, on Piciformes; and 8, or 4 per cent, on Falconiformes).

The data are as yet too fragmentary for a more detailed analysis and particularly to decide whether any of the 60 Nearctic passerines are either preferred or only stray hosts. At present, the song sparrow, *Melospiza melodia,* heads the list with 23 verified records, followed by the American robin, *Turdus migratorius,* with 8, and the chipping sparrow, *Spizella passerina,* with 7. These three birds are also favored by *Ornithomyia fringillina.* The remaining passerines are divided as follows: 1 with 6 records, 4 with 5 each, 5 with 4, 6 with 3, 7 with 2, and 28 with 1. The scarcity of records from redwing, *Agelaius phoeniceus,* catbird, *Dumetella carolinensis,* brown thrasher, *Toxostoma rufum,* and cowbird, *Molothrus ater,* is remarkable in view of the decided predilection of *Ornithomyia fringillina* for these birds.

As noted in Part I (p. 229), infestations of Passeriformes with *O. vicina* are usually light, perhaps because they are kept in check by the host (Part I, p. 130). An additional heavy infestation is that of a juvenile *Junco phaeonotus dorsalis,* in Arizona, which carried 14 flies. The species is often abundant on owls, which may be important winter hosts of *O. vicina,* as some owls are permanent, year-round residents in the northern United States. It is as yet unclear how the *O. vicina* of the passerines hibernate. Presumably some adult flies travel south in the fall on the migrating hosts; but whether any return north in the spring is unknown.

The 39 verified Neotropical records are too few to warrant much discussion. The Passeriformes predominate (15, or 38 per cent of the records) and appear to be the main breeding hosts in the tropics. That captures on toucans (Ramphastidae) and tropical owls are few may be due to the fact that small flies are easily overlooked on

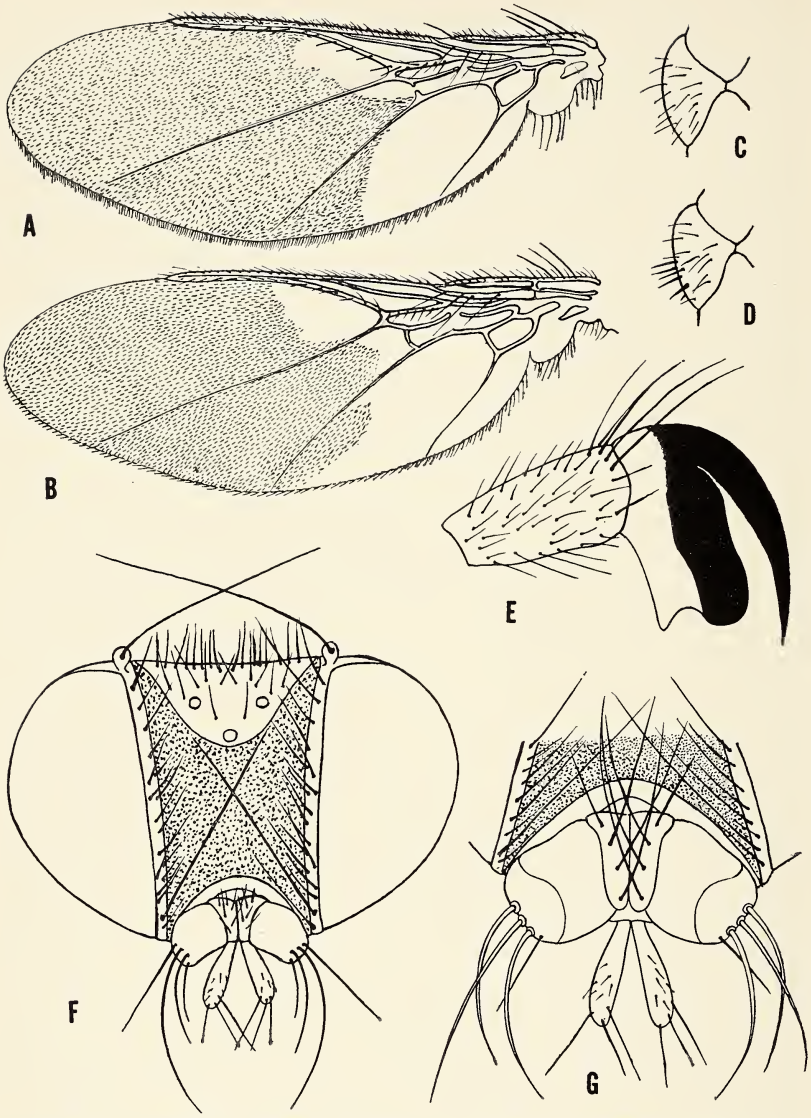

Fig. 24. *Ornithoica vicina* (Walker). **A–B**, wings showing variation in extent of microtrichia: **A**, ♀, Ponchatoula, on *Dendrocopos p. pubescens;* **B**, ♀, Wenham, on *Bubo v. virginianus.* **C–D**, trochanters of hind legs: **C**, ♀, Sauvies I., on *Bubo virginianus saturatus;* **D**, ♂, Nova Teutonia, on *Uroleuca cristatella.* **E**, distitarsus and claw of hind leg, ♀, Palo Alto, on *Zonotrichia coronata.* **F**, head, ♀, Orient, on *Pipilo e. erythrophthalmus.* **G**, frontal area and antennae, ♀ (corrected Fig. 5**C**).

such birds. Presumably both groups contain true breeding hosts also.

O. vicina is often infested with mites and I recorded 10 cases of phoresy of Mallophaga by this fly (Part I, pp. 151–152 and 167–168).

The puparium (Figs. 23*F-G*) is broadly elliptical from above, scarcely wider posteriorly, lenticular and equally convex on both faces in side view, the edges forming rounded keels. The largest of 3 puparia from the ears of *Bubo virginianus,* at Wenham, is 2.3 mm. long, 2 mm. wide, and about 1 mm. thick. The slightly raised posterior cap is divided dorsally and ventrally by a median depression ending in a curved notch; a deep, circular, apical pit occupies the space between the dorsal and ventral notches. Each half cap, or peripneustic lobe, comprises 3 low, radiating ridges, bearing each 15 to 20 scattered, minute spiracular pores, and separated by shallow and narrow grooves. The integument is bare, shiny and very smooth, with only faint traces of anastomosing engraved lines in a few spots. There is no trace of segmentation; but slight longitudinal depressions set off the lateral keels dorsally and ventrally. Puparia of *O. vicina* are sometimes found in the plumage or ears of owls (Part I, p. 189).[28]

Affinities. The description of *O. promiscua* by Ferris and Cole (1922), the additional notes by Ferris (1929), and the characters of my key should suffice to recognize *O. vicina.* The wing is 2.8 to 3.7 mm. long. The venational peculiarities are perhaps more reliable for this fly than usual in the family. The apical, deflected part of the 3rd longitudinal vein is usually slightly longer than the basal, free part; it runs almost in contact with the costa or is only narrowly separated; the anal cell is about twice as long as wide or slightly longer; the posterior basal cross-vein ends somewhat before mid-length of the 2nd basal cell. The scutellum bears normally 4 long preäpical bristles, in 2 pairs, exceptionally 5 or even 6. There are 15 to 18 inner orbital bristles, a few very long and some very short. The characteristic extent of the microtrichia on the wing, first figured by Lutz, Neiva and da Costa Lima (1915, as *O. confluenta*), varies (Figs. 22 and 24*A-B*), but never approaches that of the true *O. confluenta.* Abnormal additional veins, very unusual in hippoboscids, are shown in Figs. 23*C-E.*

[28] Puparia of *Ornithoica pusilla* have recently been reported from the ears of *Asio flammeus sandwichensis,* in Hawaii (Adachi, 1954).

Ferris and Cole (1922) noted that the American *O. vicina* (their *O. promiscua*) and the Old World *O. turdi* (Latreille, 1812) were closely related, the extent of the microtrichia in the wing being about the same in both. Upon comparison, *O. turdi* is somewhat smaller, the wing being only 2 to 2.5 mm. long, with a shorter and wider anal cell, usually about 1½ times as long as its greatest width (in *O. vicina* about twice as long as wide). Since these differences appear to be constant, it is advisable to retain the two species as distinct until the genus is revised on a world-wide basis.

Original description of *O. vicina:* "Picea, capite, humeris, abdominis basi et segmentorum marginibus posticis apice fulvis, femoribus basi coxisque pallidioribus, tarsis piceis, alis subfuscis. Body pitchy, smooth, shining: head, shoulders and base of the abdomen dark tawny: tip of the abdomen beset with black bristles; hind borders of its latter segments pale: legs tawny, clothed with black hairs; thighs at the base and hips pale tawny; feet pitchy; claws black: wings pale brown; veins pitchy; fore border veins at intervals, and wing-ribs pale tawny; second longitudinal vein united to the costal vein long before the end of the latter. Length of the body 1 line [2.2 mm.]; of the wings 4 lines [span of wings, 8.8 mm.]." Dr. F. van Emden, who examined the type at the British Museum at my request, sent me the following information, which I confirmed later (1951) myself. The type is a male, the protruding penis ending in a broadish lamina of chitin. Microtrichia cover slightly more than the apical half of the wing, forming only a small patch at the apex of the 3rd posterior cell. The interocular face is slightly wider than an eye, hardly widened at postvertex, almost parallel-sided. The wing is 3.7 mm. long. These characters are those of the common American species. Although Walker mentioned only one specimen, a second male, from the same host, "*Ephialtes* [*Pseudoscops*] *grammicus,*" and locality, now stands with it. This has a slightly wider interocular face than the type, but agrees otherwise.

Original description of *O. promiscua:* "Female. Length (on slide) 2.5 mm. A yellowish-brown species, the thorax darker than the legs. Head with the frons [interocular face] probably almost parallel-sided in perfect specimens but in the holotype curving in slightly. Frontal orbits with at least three strong setae and several smaller setae. Ocellar setae small. Ventral side with a row of slender setae more or less paralleling the orbits. Thorax with several short, stout, black setae on the humeral callosities and on the margin in front of the wing. Mesonotum with numerous small, pale setae, all with distinct pustulations about the base. There is a single long seta just behind the humeral callosity, two in front of the wing and one just behind the wing. Scutellum with small, pale, pustulated setae on the disc and with four long, black setae. Halteres rather small and delicate. On the ventral side both meso- and meta-sternum are beset with numerous fine setae, mingled with a few that are small and stout. Wings with a well-defined anal cell; R_{2+3} [3rd longitudinal] distinctly curved toward the costa and bristly to the tip; *m-cu* [anterior basal] cross-vein broken, the upper part obsolete; vein above cell 2*M* [4th longitudinal], broken near the middle; distal half of the wing covered with microscopic setulae as shown in the figure. Legs comparatively strong, the anterior femora noticeably thickened; setae arranged in a rather definite fashion, as shown in the figure. Claws rather slender. Abdomen above with a chitinized basal plate extending from side to side, with four quite large plates occupying the median half and with a small plate on each side of the anal region, the basal plate and the succeeding four with numerous small setae and the para-anal plates or their immediate region with two long setae. Lateral margins with a number of small, stout

setae which are borne on tubercles. On the ventral side there is a median region beset with small setae, a region along the anterior, lateral margin with numerous setae on tubercles and a smaller region of these near the genital opening. Near the genital opening there is also a pair of small plates bearing several slender setae.'' I have seen the original type series of *O. promiscua*, all females mounted on slides, the holotype and one paratype, at the California Academy of Sciences, and two paratypes, at Stanford University; also the two flies, both females, tentatively referred to *promiscua* by Ferris and Cole. All these specimens belong to what is here called *O. vicina* (Walker).

Original description of *O. melaleuca* (translated from the German): ''Larger species. Abdomen white, metallic greenish-black above, with white margins of the segments. Head mahogany-brown above, yellowish-brown on vertex, also lighter on the side margins, without sharply defined darker spot in the middle. Antennal appendages shiny blackish-brown, with the 3 setae curved downward, as drawn by Rondani. Eyes pale brownish-red (specimen preserved in spirit, hence the color may be somewhat faded). Ocelli black. Head tawny-yellow beneath. Mesonotum depressed medially before the scutellum, metallic blackish-green. Humeral callosities pale yellowish-brown as in the other species, covered with scattered black hairs; a broad pale yellowish-brown streak runs from the humeral callosities to below the bases of the wings. Scutellum with black setae at the margin. Upper femora of fore legs not especially thickened, pale yellowish-brown with a broad brown longitudinal streak above, which covers them almost completely except at the base. Upper femora of mid and hind legs almost entirely pale brown, except for the broad pale yellow base. Fore tibiae brown with paler base. Mid and hind tibiae pale brown, with the narrow yellow ring at the basal third present also in some other species. Tarsi brown, the first segments with pale rings. Claws black. Wings lightly clouded with gray; the venation exactly as figured by Speiser, therefore not as shown by Rondani, whose figure is erroneous (according to Speiser's and my observation). Halteres yellowish gray-white. Abdomen almost pure white, with a weak yellowish-gray tinge, sparsely black hairy above and below; the first 5 segments (here distinct, as contrasted with most other hippoboscids) above with very broad, shiny greenish-black bands, which leave free only the white margins and sides of the segments. The first black band continues on each side into a short, likewise black pleurite. Last segment grayish-white, with a shiny black streak at the side margins, beneath with numerous punctiform warts and with black setae. Length in spirit 3.1 mm.; from oral margin to hind margin of scutellum, 1.9 mm.; of wing, 3.5 mm.'' I have not seen the type, which should be at the Berlin Museum. *O. melaleuca* is here referred to *O. vicina* from the description and Bau's key. These mention no truly specific character, color differences being wholly unreliable in this genus. I have seen Cuban specimens differing in no respect from other *O. vicina*.

Ornithoica confluenta (Say)

Figs. 25*A-C* and 26*A-B*

Ornithomyia confluenta Say, 1823, Jl. Ac. Nat. Sci. Philadelphia, **3**, p. 103 (no sex. United States, without more precise locality, on ''*Ardea candidissima*'' [*Leucophoyx t. thula*]. Type lost); 1837, Oeuvres Entomologiques, edit. by Gory, p. 104; 1859, Complete Writings, edit. by Leconte, **2**, p. 88.

Ornithoica confluenta Speiser, 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40**, p. 558 (no specimen seen); 1907, Ent. News, **18**, p. 103 (in part). Bau, 1922, Centralbl. Bakt. Parasit., Abt. 2, **57**, p. 278; 1929, Zentralbl. Bakt. Parasit., Abt. 2, **79**. pp. 247 and 248 (in part). J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, p. 326. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, No. 4, p. 394. Not of most authors.

Anthoica (?) confluenta Coquillett, 1899, Canad. Entom., **31**, p. 335.

Ornithoeca confluenta Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303 (in part).

Ornithomyia confluens Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 611 (emendation of *confluenta;* specimen possibly seen, although Say's description is copied; locality surmised to be Pennsylvania). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 214. Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 229.

Ornithoica confluens Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655 (in part).

Ornithoica confluenta var. *exilis* Bau, 1929, Zentralbl. Bakt. Parasit., Abt. 2, **79**, pp. 247 and 248 (in part: record from Amboina, on "*Ardea alba*" only). Not *Ornithomyia exilis* Walker, 1861.

Ornithoica beccariina Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 160, fig. (no sex. Amboina: on "*Ardea alba*" [*Casmerodius albus modestus*]. Two ♀ cotypes on one pin and one ♀ cotype mounted on a slide by Ferris, all at Genoa Mus.). v. Röder, 1892, Jahrb. Hamburg. Wiss. Anst., **10**, pt. 2, p. 206. Speiser, 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40**, pp. 557–559, fig. (in part: 3 cotypes only; new description, but sex not determined). Bau, 1922, Centralbl. Bakt. Parasit., Abt. 2, **57**, p. 278. Ferris, 1929, Canad. Entom., **61**, p. 281, figs. 1 and 2*A* (♀ cotype of Rondani, with descriptive notes).

Ornithoica podicipis v. Röder, 1892, Jahrb. Hamburg. Wiss. Anst., **10**, pt. 2, p. 206 (no sex. Zanzibar: on *Podiceps* sp. Cotypes at Hamburg Mus., now destroyed, and in the v. Röder Coll., now at the Zoolog. Institut, Halle a. S.). Speiser, 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40**, p. 559. Bau, 1922, Centralbl. Bakt. Parasit., Abt.. 2, **57**, p. 278. Ferris, 1929, Canad. Entom., **61**, p. 285 (locality given by error as Australia).

Ornithoeca podicipis Speiser, 1907, Wiss. Ergebn. Schwed. Zool. Exped. Kilimandjaro Meru, **2**, pt. 10, p. 3; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 245. Bezzi, 1908, Bull. Soc. Ent. Italiana, **39**, (for 1907), p. 197. Neave, 1912, Bull. Ent. Res., **3**, p. 318. Aders, 1917, *Op. cit.*, **7**, pt. 4, p. 400 (Zanzibar: on a species of heron).

Ornithoica confluenta var. *podicipis* Bau, 1929, Zool. Anzeiger, **85**, p. 11 (saw 5 cotypes from Hamburg Mus., now destroyed, and 4 cotypes in the v. Röder Coll. at Zoolog. Institut, Halle a. S.; new description, but sex not determined); 1929, Zentralbl. Bakt. Parasit., Abt. 2, **79**, pp. 247 and 248 (notes on cotypes).

Distribution and Specimens Examined. United States. Florida: two ♀ without more definite locality, on *Casmerodius albus egretta,* at M.C.Z. (J.A. Allen, 1863). Say's original specimen or specimens may also have come from Florida.

Antilles. Bahamas: Booby Cay, Mariguana Island, 19 ♀ on *Butorides virescens bahamensis,* July 21, 1930 (H.S. Peters).

Venezuela: Cantaura, State of Anzoategui, 6 ♀ 2 ♂ on *Bubulcus i. ibis,* Aug. 25, 1948 (F.D. Smith).

Brazil (specimens received from the Departamento de Zoologia, São Paulo, through Dr. L.R. Guimarães): State of São Paulo, without more precise locality, 1 ♀ on *Casmerodius albus egretta,* June, 1946; Osasco, State of São Paulo, 5 ♀, 1 ♂ on *Casmerodius albus egretta,* July 26, 1946.

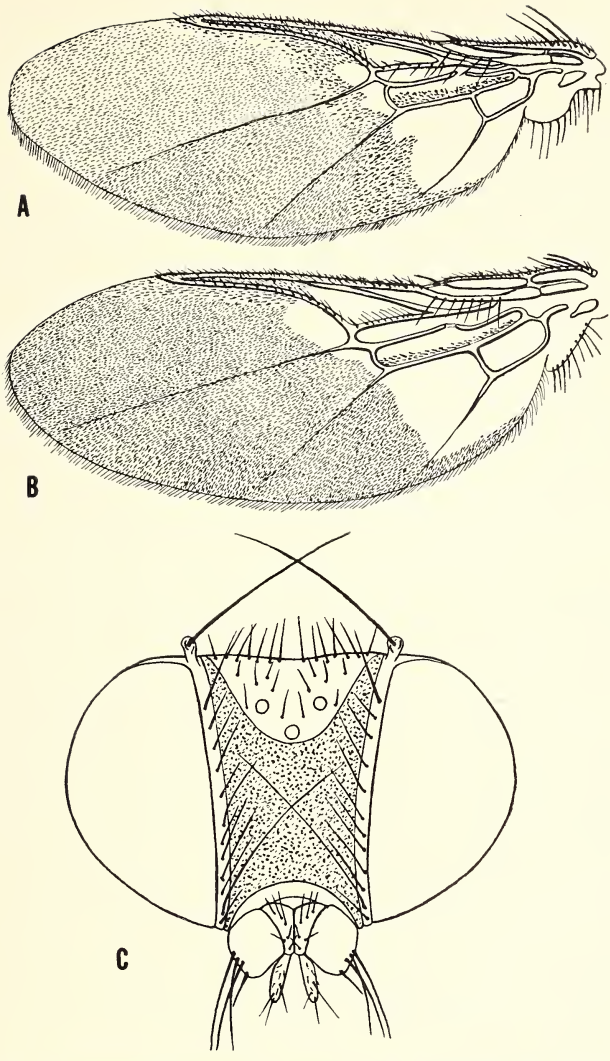

Fig. 25. *Ornithoica confluenta* (Say). **A–B**, wings: **A**, ♀, Booby Cay, on *Butorides virescens bahamensis;* **B**, ♀ cotype of *Ornithoica beccariina* Rondani, Amboina, on *Casmerodius albus modestus.* **C**, head, ♀, same data as **A**.

If the synonymy here proposed is correct, *O. confluenta* will be world-wide, at least in tropical and subtropical areas. In the Old World there are reliable published records from Zanzibar I. and Indonesia (Amboina). I have also seen specimens from Africa (Daressalaam, Tanganyika Terr., on egret; Zanzibar I., on small buff-backed heron; Butiaba, Uganda, on *Ixobrychus minutus payesi;* Leopoldville, Belgian Congo, on heron; Old Blantyre, Nyasaland, on small heron) and Madagascar (on *Bubulcus ibis*).

The following published records for *O. beccariina* do not refer to the true *O. beccariina* (= *confluenta* Say), from wading birds, but to *Ornithoica pusilla* (Schiner): Speiser, 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40**, p. 557 (specimen from Stephansort, New Guinea, on *Diphyllodes magnificus,* a bird of paradise); Speiser, 1902, Természs. Füzetek, **25**, p. 334 (New Guinea: near Simbang on Huon Gulf, without host; Friedrichs-Wilhelmshafen, on *Dacelo* [*"Sauromarptis"*] *gaudichaud,* a kingfisher); Ferris, 1924, Ent. News, **35**, p. 235 (Borneo; referred to *pusilla* by Ferris, 1929). I have seen specimens of *O. pusilla* from *Dacelo gaudichaud,* from Hollandia, New Guinea (H. Hoogstraal Coll.).

Known American Hosts of *O. confluenta* (verified individual records in parentheses). Ciconiiformes (5): *Casmerodius albus egretta* (3); *Bubulcus i. ibis* (1); *Butorides virescens bahamensis* (1); *Leucophoyx t. thula.*

Bionomics. *O. confluenta* has now been taken in America on six occasions from four different species of waders. It occurs in the Old World also on this type of host and is evidently a specific parasite of Ciconiiformes. I suspect that it is more common than the few recorded captures might indicate. If it actually uses only wading birds as breeding hosts, its small size might make it difficult to find and to collect on large birds with very long plumage. Possibly also it may be restricted to tropical and subtropical areas, where little collecting of ectoparasites has been done. Sometimes it seems to be fairly abundant on an individual host. The single record from a grebe (*Podiceps*) in Africa may have been based either on a stray or on a contamination. The puparium is as yet unknown.

Affinities. Until recent years, Say's trivial name *confluenta* was applied to the common American *Ornithoica* of passerine and other birds, in the belief that the genus contained only one species in the New World. When it was found that American wading birds harbor another species, the question arose as to how Say's name should be used. The type is lost and the original description fits either species. However, Walker's later name *vicina* is certainly

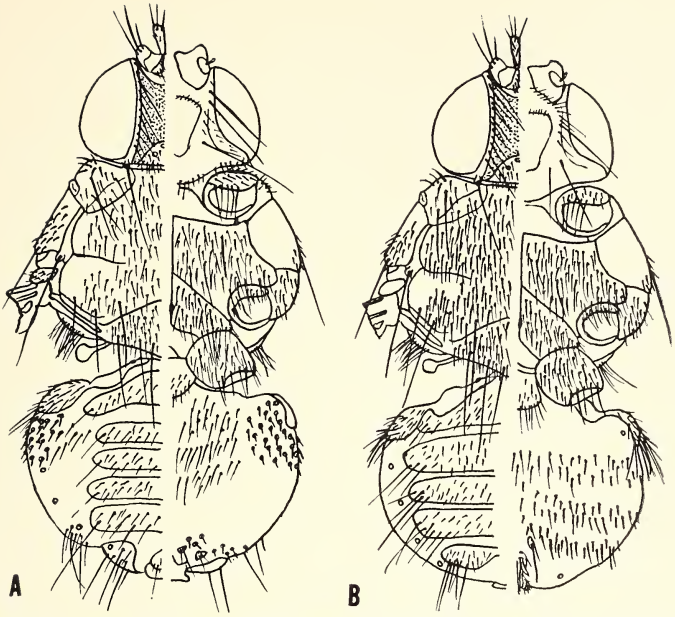

Fig. 26. *Ornithoica confluenta* (Say). Body in dorsal and ventral view: **A**, ♀, Booby Cay, on *Butorides virescens bahamensis;* **B**, ♂, Osasco, on *Casmerodius albus egretta.*

based upon the common species from non-wading birds, as shown by his type. Since, on the other hand, Say's species was originally described from a wader, it seems reasonable to use his name *confluenta* for the species known at present only from waders. There is nothing in Say's description to contradict this. The only other alternative would be to discard Say's name altogether and call the louse-fly of waders by the next older name, *Ornithoica beccariina* Rondani; but such a course seems both unnecessary and unfair to the Father of American Entomology.

O. confluenta is about the size of *O. vicina,* the wing being 3 to 3.6 mm. long. The apical confluent stretch of the 3rd longitudinal vein is nearly as long as the basal free portion and is separated from the costa by a narrow membrane almost to the very tip. The pilosity of the body is somewhat more developed than in *vicina:* the inner orbit bears a row of 8 to 12 setae and the scutellum 3 or 4 pairs of preäpical bristles, some longer than others. I am unable to separate the Old World *O. beccariina* Rondani and *O. podicipis* v. Röder from the American species here called *confluenta.*

Original description of *O. confluenta:* "Reddish-brown; costal nervures of the wing confluent before their termination. Vertex with a deeper brown spot; occiput pale yellowish; humerus with a pale spot, the angles not at all produced, obtuse; costal nervures fuscous; feet yellow-brown, tibia with a dark-brown line, nails black. Length rather more than $\frac{1}{10}$ of an inch [2.5 mm.]. The remarkable character of the costal nervures of this species sufficiently distinguish it from others; these nervures are confluent about half the length from the termination of the first cellule to their tip." Say gave no locality and there is no proof whatsoever that his type came from Pennsylvania, as Wiedemann surmised.[29] C. W. Johnson (1922, p. 80) supposed that the type might have been collected either in Pennsylvania or west of the Missouri, rather a wide range of territory. More probably it came from Florida, where the snowy egret, the type host, was very common in Say's time. Although Wiedemann merely copied Say's original description, he may have received a specimen, since he did not precede the name with a cross (†), a sign he used for species he did not see. It would be interesting if a Wiedemann specimen could be traced at the Vienna Museum or elsewhere, as it would be the only type extant.

Original description of *O. beccariina:* "Long. corp. mill. 2–2¼. Nigricans, humeris aliquando sordide testaceis. Antennae apice magis vel minus pallido, setis apicalibus nigris, paucis, longis, una longiore. Alae dilute fuscae, vena costale punctis pallidis notata, aliquibus, prope basim, uno contra apicem venae secundae longitudinalis, quae in costa satis distat a tertia magis quam tertia a quarta: transversa intermedia antice incompleta et magis proxima exteriori quam axillari: istarum exteriore satis ante apicem sita tertiae longitudinalis. Pedes plus vel minus nigricantes, femoribus basi, et annulo medio tibiarum, praesertim posticarum, pallidioribus vel sub-testaceis." Speiser (1900) published some additional information, after examining Rondani's types; but it is not certain that the following remarks (translated from the German) refer all to these types, since he studied also a specimen from a bird of paradise, most probably belonging to *O. pusilla* (Schiner). He states that, in addition to the humeral callosities, the episterna [anepisterna] of the mesothorax also are brownish-yellow and that Rondani's figure of the venation is erroneous: "while a small angle is produced where the cubitalis [3rd longitudinal] branches from the radialis [2nd longitudinal], the knee-like bend of the discoidalis [4th longitudinal] enters this angle, so that the anterior basal cell [1st basal] is actually equally wide throughout in *beccariina* also. . . . The entire surface of the wing is very slightly clouded with gray; the veins are brown, but white at certain characteristic spots, however not discolored but seemingly with white pigment. These spots are: in the costalis [costa] a small stretch beyond the basal cross-vein [humeral cross-vein], as well as at both sides of the tip of the subcostalis [subcosta]; its extremity also is white; furthermore the knee-like upward bend of the discoidalis [4th longitudinal] and the anterior half of the posterior cross-vein." A new, corrected figure of the venation is added. The characteristic pattern of microtrichia, specific for *confluenta,* was first shown by Ferris (1929), drawn from a female cotype of *beccariina,* together with the dorsal and ventral aspects of thorax and abdomen. These figures leave no doubt that the *Ornithoica* usually occurring on waders in the New World, is identical with what Rondani described as *beccariina.* Ferris' remarks on this type follow: "It may be noted especially that in the wing the vestiture of minute setae, which occur on both sides of the wing, extends from the vein M_3 (2nd cross-vein) [posterior cross-vein] across the cell Cu [3rd posterior] into the apex of the second anal cell [axillary]. The abdomen possesses four tergal plates in addition to the basal and the paired

[29] Wiedemann (1830, **2**, p. v) assumed that all Diptera described without locality, which he received from Say, were collected in Pennsylvania, probably because they were sent from Philadelphia.

sub-apical plates. At the lateral margins, just caudad of the basal plate and extending well around onto the ventral side, is an area beset with strong tubercles, each of which terminates in a small, stout, thorn-like seta. There is also a cluster of such tubercles, in part bearing more than one seta, on each side of the venter near the apex. One of these, on each side bears a cluster of slender setae. On the lateral margin of the dorsum, just cephalad of each sub-apical plate, is a conspicuous cluster of large, slender setae. The legs show no distinctive features. There is no spur at the apex of the posterior tibiae and the trochanters of the posterior legs are devoid of stout black setae.'' Ferris points out that *O. beccariina* differs from both *O. vicina* (which he calls *confluenta*) and *O. pusilla* in the distribution of the microtrichia on the wing, since in both last-named the microtrichia enter the 3rd posterior cell only at its extreme apex and are not present in the axillary cell at all. *O. pusilla* agrees with *beccariina* in having a tuft of long, slender setae on the lateral margin of the abdomen just cephalad of the sub-apical plates, which tuft is entirely lacking in *O. vicina.* I have recently (1951) examined the type series of *beccariina* at the Genoa Museum. It now consists of a pin bearing two dry specimens, apparently both females, and an additional female mounted on a slide (by Prof. Ferris). These types confirm the conclusion reached from published information. Their wings are 4 mm. long.

Original description of *O. podicipis* (German text translated): ''Nigra; humeris, lateribus thoracis pedibusque flavis, alis dilute fuscis. Long. corp. 2½ millim., long. alar. 3 millim. The venation is in this species also almost the same as in the other two species [*beccariina* Rondani and *turdi* Latreille]. The 3rd longitudinal unites over its apical third with the costa. The anal cell is very distinct. As for distinguishing the 3 species of *Ornithoica,* the anterior basal cell [1st basal cell] is widened in *beccariina,* but of equal width throughout in *podicipis* and *turdi.* The distinction between *podicipis* and *turdi* is in the longer united stretch of 3rd longitudinal and costa in *podicipis,* while this union is much shorter in *turdi.* The posterior basal cell [2nd basal cell] is somewhat shorter than the anterior [1st] in *podicipis;* both basal cells are of about the same length in *turdi.*'' Both Speiser and Bau pointed out that the 1st basal cell is of equal width throughout in *beccariina* also (Rondani's original figure being erroneous in this respect). Bau (1929) gave a new detailed description (here translated from the German) of the types of *podicipis,* which he regarded as a variety only of *confluenta:* ''Vertex [interocular face] flat, parallel-sided, dull grayish-brown, the inner orbits strongly raised and swollen, on the occiput [postvertex] with two long setae and likewise above the antennae with two long setae, curved backward. Antennal appendages with one strong and two smaller setae, curved downward. Maxillary palpi short, straight, extending only a little beyond the antennal appendages. Head at sides and beneath dirty yellow to brownish-yellow, with a few setae beneath. Thorax and scutellum grayish-brown, the weakly produced humeral callosities dirty yellow, but in one specimen scarcely paler. Scutellum posteriorly with a few long, erect setae. Pleura dirty yellow, with a broad, dark brown longitudinal streak above the coxae, the streak sharply defined in two specimens only, blurred and indistinct in the others. Wings with the characteristic venation of *Ornithoica,* brownish smoky-gray, in the basal third with a broad, not sharply defined, whitish, almost vitreous cross-band, which includes the cross-veins. The darker areas of the base and apical half of the wing are due to a microscopic pilosity of the wing surface (according to Ad. Lutz). The veins with the usual interrupted white stretches. The 2nd longitudinal ends far beyond the imaginary extension of the small cross-vein [anterior cross-vein]; the imaginary extension of the anal cross-vein toward the costal margin falls on the whitish pigmented elbow of the 4th longitudinal (as in *beccariina,* according to Speiser). Anterior [1st] basal cell equally wide throughout; posterior [2nd] basal cell shorter than the anterior [1st] for about the length of the small [anterior] cross-vein. Posterior [anterior basal] cross-

vein almost completely white-pigmented, scarcely visible in some specimens. Legs: fore femora yellow to dirty yellow, mid and hind femora yellowish at base only, otherwise more or less brownish; all femora with erect, long setae. Fore and mid tibiae yellowish-brown, more brownish in some specimens, the hind tibiae darker brown with a yellow, usually inconspicuous ring at basal third; first two tarsal segments, particularly of the hind legs, with a basal yellow ring. Some specimens have also a trace of a yellow ring at the basal third of the mid tibiae. Outer surface of tibiae with a few long setae placed far apart. Claws simple, bidentate, black. Abdomen dark brown, paler beneath, setose at apex. Length 2½ mm. Wing 3 mm.'' I have not seen any of the types of *podicipis;* but the available information is sufficient to regard it as identical with *O. confluenta* of wading birds, rather than with the common African *O. turdi.*

Austen (1903, p. 263) considered that the type of *Ornithomyia exilis* Walker (1861, p. 254; no sex; no host; New Guinea: Dorey) was not separable from *O. beccariina* Rondani; but I do not agree with this conclusion. Dr. F. van Emden, who examined the type of *C. exilis* at my request at the British Museum, kindly sent me a sketch of the extent of the microtrichia on the wing. This is as in *O. vicina,* not as in *O. confluenta* (= *beccariina*). I confirmed this later (1951) by direct examination. The true identity of *Ornithoica exilis* (Walker) is outside the scope of the present paper.

2. Subfamily Ornithomyiinae

Ornithomyia Latreille, 1802

Ornithomya Latreille, 1802 (An X), Hist. Nat. Crust. Ins., **3**, p. 466 (with description; monotypic for *Hippobosca avicularia* Linnaeus, 1758); 1803 (An XI), Nouv. Dict. Hist. Nat., **16**, p. 380 (with fuller description; same type).

Ornithomyia Latreille, 1804 (An XII), Nouv. Dict. Hist. Nat., **24**, Tabl. Méthod., pp. 197 and 198 (author's emendation of *Ornithomya;* monotypic for *Hippobosca avicularia* Linnaeus, 1758); 1805 (An XIII), Hist. Nat. Crust. Ins., **14**, p. 402.

Ornithomyja Fabricius, 1805, Syst. Antliat., p. 338 (error for *Ornithomyia,* in the combination *Ornithomyja avicularia* Latreille, as a synonym of *Hippobosca avicularia*).

Ornithomys ''Latreille'' Meigen, 1804, Klassif. Beschreib. Europ. Zweifl. Ins., **1**, pt. 1, p. xxiii (error for *Ornithomya*).

Ornithomyza ''Leach'' Zetterstedt, 1842, Dipt. Scandinaviae, **1**, p. 82 (with description, but without species); 1848, *Op. cit.,* **7**, p. 2902; 1849, *Op. cit.,* **8**, p. 3366 (possibly an emendation of *Ornithomyia;* same type, *Hippobosca avicularia* Linnaeus, the only species mentioned in 1848, by present designation).

Ornythomia Lasaulce, 1844, Bull. Soc. Hist. Nat. Dépt. Moselle, Metz, **2**, p. 20 (error for *Ornithomyia,* in the combination *Ornythomia viridis* ''Degeer,'' on *Hirundo rustica* [= *Ornithomyia biloba* Dufour, 1827]; also spelled *Ornythomyia* on pp. 21 and 22).

Ornithymia ''Latreille'' Bezzi, 1904, Kat. Paläarkt. Dipt., **4**, p. 277 (error for *Ornithomyia*).

Onithomyia Shipley, 1911, Science Progress in 20th Century, London, **5**, (for 1910–1911), No. 20, p. 570 (error for *Ornithomyia*).

Ornitomyia Bezzi, 1892, Bull. Soc. Ent. Italiana, **24**, p. 148 (in the combination *Ornitomyia avicularia;* error for *Ornithomyia*). [*Ornitomyia* Dugès, 1887, was used in the combination ''*Ornitomyia villadae*'' for a species of *Lynchia.*]

Ornithomia Kirby and Spence, 1826, Introduction to Entomology, **4**, p. 86 (in the combination *Ornithomia avicularia;* error for *Ornithomyia*).

Ornothomyia E. P. Reed, 1932, Rev. Chilena Hist. Nat., 35, (for 1931), p. 102 (error for *Ornithomyia*, in the combination *Ornothomyia chiliensis* E. C. Reed = *Ornithomyia parva* Macquart).

Ornithomayia Kishida, 1932, in Esaki, Iconogr. Insect. Japon., p. 244 (error for *Ornithomyia*, in the combination *Ornithomayia aobatonis* Matsumura = *Ornithomyia avicularia* Linnaeus).

Generic Characters. Fully-winged parasites of birds, not metallic-greenish, often with dull-green pigment in the haemolymph visible through the integument in life. Head inserted between prominent humeral callosities; occiput covering anterior margin of thorax. Ocelli present in most species, sometimes small; more rarely rudimentary or lacking. Eyes large, occupying most of sides of head, with many minute, well-defined ommatidia. Postvertex and frons far apart; intervening soft mediovertex much longer than either. Occipital margin straight or slightly arched. Frons divided by a deep transverse suture into a broad lunula (usually with a median pit or depression) and a narrow interantennal area; the latter rather long basally, ending in a narrow, evenly concave emargination; apical arms moderately long, diverging, mostly membranous except for narrow sclerotized edges near the antennal pits. Antennae medium-sized: 1st segment at least partly separated by a suture from side of lunula; 2nd segment with a moderately long appendage, slightly widened basally and gradually narrowed to a blunt point, not extending to tips of palpi; both appendages diverging, leaving apical arms of frons and palpi fully exposed; arista flattened, gradually widened, slightly spatulate at apex. Palpi moderately long. Pronotum very short, not visible from above. Humeral callosities large, produced forward as broad, bluntly pointed lobes; posthumeral suture deep at sides, superficial or vestigial medially; prothoracic spiracle very large, placed close to hind margin of callosity. Anterior margin of prescutum nearly straight; transverse mesonotal suture deep, straight, narrowly or broadly interrupted medially, usually placed before hind third of mesonotum; anterior ridge of parascutellum fused with mesoscutum; median notal suture superficial, but complete from anterior margin to near scutellum; notopleuron set off throughout from prescutum, wedge-shaped, very narrow anteriorly, much broader posteriorly. Dorsal portion of anepisternum broad, lathe-shaped, parallel-sided, with blunt, scarcely or not projecting outer hind edge. Scutellum large, elliptical, with strongly convex hind margin; surface flat, with a slight median triangular depression connected with a more or less pronounced preäpical transverse groove; scuto-scutellar suture mostly deep, superficial at extreme sides.

Fig. 27. *Ornithomyia fringillina* Curtis, ♀, Berkeley, on *Passerella iliaca*, subsp. × about 13.

Pleurotergite of metathorax low, transverse, convexly swollen, without process. Basisternum of prothorax separated from mesosternum by a complete suture, forming two broadly triangular, bluntly conical, intercoxal lobes. Mesosternum divided into basisternum and furcasternum by a complete, broadly V-shaped suture (with blunt forward angle ending in a furcal pit). Metasternum undivided, sharply triangular anteriorly, its hind margin slightly produced and evenly rounded in the middle; no metasternal spur near hind coxa. Median longitudinal suture over part or whole of mesosternum only. Metathoracic spiracle placed as in *Ornithoctona*. Legs long, moderately robust; femora slightly swollen; tibiae flattened; tarsal segments 1 to 4 short, broad; hind basitarsus much lengthened, in both sexes with a transverse basal comb of stiff setae beneath (Fig. 29*F*); tips of all tibiae normal; tibial spurs weak.

Claw (Fig. 29*E*) divided throughout into two teeth of about equal length, the terminal one very sharp, the inner one blunter; in addition, a shorter, tooth-like, but blunt, basal "heel" (claw seemingly tridentate). Wing large, with the complete venation for the family (Fig. 13*A*), including three cross-veins; anterior basal cross-vein placed almost at, or a short distance basad of, anterior cross-vein; 1st and 2nd basal cells of about equal length; 2nd basal cell at least twice as long as anal cell; 1st, 2nd and 3rd longitudinal veins ending at a sharp angle in the costa; subcosta complete, ending in costa; small bullae in anterior basal cross-vein and in basal elbow of 4th longitudinal; posterior basal cross-vein slanting, upper apical corner of anal cell acute; costa and basicosta setulose; all other veins bare; no strong bristle on costa basad of apex of 1st longitudinal vein; membrane partly covered with microtrichia on upper side; also on under side over a small area at the apex of the 1st posterior cell, which appears darker as a result; alula very large; calypteres much reduced; upper calypter very short, partly thickened at the setulose margin, separated by deep notches from both alula and lower calypter; the latter a narrow, semi-membranous ledge continuous with the posterior ridge of the parascutellum, with thickened, finely setulose hind margin. Abdomen dorsally with a few small, median sclerites, sometimes reduced to the preänal pair; basal pleurotergites fused medially; no striate median area. Seven pairs of abdominal spiracles placed as in Figs. 28 *A-B*. Body moderately setose; orbital bristles few, in one row; one vertical bristle on each side; under side of head with many bristles on the lateral ridges bordering the buccal cavity; chaetotaxy of thorax mostly obscured; disk of mesonotum nearly bare; sometimes a few distinct prescutellars and a few short postalars; one long notopleural; scutellum with an apical fringe of soft hairs and a row of preäpical bristles, the disk with or without short setae; pleurotergite setulose. Abdomen fairly uniformly covered with short setae; longer bristles in certain areas or on the tergal sclerites. Male terminalia (Figs. 29*C–D*) as in *Ornithoctona:* gonocoxites reduced to very small, finger-shaped, setigerous lobes (easily overlooked); two penis valves slender, sharply pointed; penis also slender, rod-like, bluntly pointed.

Ornithomyia is cosmopolitan, but perhaps more common in temperate than in tropical areas. It occurs on a variety of birds; some species have a wide range of hosts belonging to unrelated orders; the more specialized forms are restricted to the Hirundinidae. Many species have been described, but probably not more than 10 or 12 are valid. *Pseudornithomyia,* originally based on a species

without ocelli, is here treated as a subgenus only of *Ornithomyia.* The development of the ocelli varies greatly in this genus, sometimes even within specific limits (*O. inocellata* Ferris). The reduction or loss of ocelli is not correlated with any other peculiarity of structure. Of the 4 American species, 3 are precinctive, the fourth, *O. fringillina,* being Holarctic and extending farther north than any other hippoboscid (Part I, pp. 121–122 and the discussion of geographical distribution in Part II).

Key to Palearctic and American Species of *Ornithomyia*

1. Ocelli rudimentary or absent. Upper orbit (measured behind the middle of the eye) at least as long as width of inner orbit. Prosternal lobes sharply triangular, about as long as wide at base. Nearly apical two-thirds of wing membrane covered with microtrichia. Wing 4 to 5.5 mm. long. (Subgenus *Pseudornithomyia*) 2

   Ocelli distinct, though sometimes small. Prosternal lobes relatively shorter and wider, more rounded at tips 3

2. Interocular face nearly twice the width of an eye in both sexes. Inner orbit about half as wide as mediovertex, greatly narrowed at lunula. Scutellum with a preäpical row of 8 to 14 bristles; disk with many long and short setae, those near the scuto-scutellar suture in an irregular row. Venter of female apically with only a few short and long setae inserted on knobs ..... *O. ambigua*

   Interocular face nearly four times as wide as an eye in both sexes. Inner orbit about half as wide as mediovertex, only slightly narrowed at lunula. Scutellum with a preäpical row of 10 to 14 bristles; disk with few setae, none forming a row near scuto-scutellar suture. Venter of female apically with many short and long setae inserted on knobs ..... *O. hoffmannae*

3. Head in front view about as high as wide or slightly higher, nearly circular. Eyes short, less than three times as long as wide. Upper orbit (measured behind the middle of the eye) at least as long as greatest width of inner orbit. Palpi about as long as antenna. Ocelli small; anterior ocellus placed on or above a line drawn along the upper margins of both eyes. Interocular face at least twice the width of an eye in both sexes. Orbital bristles in one continuous row from frontal suture to middle of mediovertex. Scutellum with setulose disk and a preäpical row of 6 to 10 bristles.

Nearly apical two-thirds of wing membrane covered with microtrichia. Wing 4 to 5.5 mm. long ..... *O. biloba*

Head in front view slightly to decidedly wider than high, transversely elliptical. Eyes relatively long. Upper orbit (measured behind the middle of the eye) shorter than greatest width of inner orbit. Palpi shorter than antenna. Anterior ocellus placed near or below a line drawn along the upper margins of both eyes. Row of orbital bristles forming two disconnected groups, one near middle of mediovertex, the other along frontal suture. Disk of scutellum with few or no setae before the preäpical row of bristles. Wing with microtrichia only over most of first posterior, apex of submarginal and sometimes narrow streaks in second posterior cells; rarely with traces elsewhere 4

4. Interocular face at its narrowest twice as wide as an eye in both sexes; at its widest (near postvertex) wider than the length of an eye. Scutellum with a preäpical row of 4 to 6 bristles. Small species; wing 4.5 to 6 mm. long ..... *O. parva*

Interocular face at its narrowest less than twice the width of an eye in both sexes, somewhat narrower in male than in female; at its widest (near postvertex) about as wide as or slightly narrower than the length of an eye 5

5. Larger species; wing 6 to 7.5 mm. long. Scutellum with a preäpical row of 6 to 10 (usually 8) bristles ..... *O. avicularia*

Smaller species; wing 4 to 5.5 mm. long. Scutellum with a preäpical row of 2 to 6 (usually 4) bristles ..... *O. fringillina*

The Old World *O. avicularia* and *O. biloba,* which do not occur in America, are included in the foregoing key in order to clarify the extralimital affinities of the American species. *O. avicularia* has often been cited from the New World, but in my opinion always by error. At any rate, all the specimens so determined which I have verified, were either *O. fringillina* (in North America) or *O. parva* (in temperate South America).

In 1951*a* (p. 8) I included *Ornithomyia biloba* Dufour in a list of Chilean Hippoboscidae, on the strength of a fly found labelled "Valparaiso, on *Turdus falklandicus.*" As there is no other evidence that this Old World species occurs in America and particularly in view of the wholly improbable host, I now believe that the specimen originated in Europe and received the Chilean label through some oversight. For the time being it is advisable to omit it from a revision of the American hippoboscids.

The following species should be deleted from the list of American Hippoboscidae: *Ornithomyia fuscipennis* Bigot, 1885 (p. 242; no sex; no host. "Colombia"). This insect was for many years very puzzling, particularly as no specimen of *Ornithomyia* agreeing with it had been found since in tropical America. In 1951 I was able to study the female type in the Bigot collection (now the property of Mr. J. E. Collin), where Bigot had labelled it *O. fuscicornis.* It is a true *Ornithomyia* related to *O. avicularia,* though distinct: it is much larger, the wing being 8 mm. long; head broader than high, with a narrow, almost parallel-sided interocular face (very slightly wider than one eye); ocelli large; inner orbit at postvertex less than half as wide as mediovertex. In all these characters the fly agrees well, upon comparison, with specimens of the large Australian species which Speiser (1902*a*, p. 331) described as *Ornithomyia perfuga.* Speiser (1902*b*, p. 167), who also saw the type, recognized that it was most nearly related to his *perfuga,* from which he thought it differed in "the somewhat more slender and especially more pointed humeral callosities, and in the costa being yellowish-brown instead of blackish-brown (like the remaining veins), particularly between the tips of subcostalis [subcosta] and radialis [2nd longitudinal]." These differences are of little value and fall within the range of intraspecific variation in *Ornithomyia.* I consider that *Ornithomyia fuscipennis* Bigot is the older, correct name of the Australian fly known hitherto as *O. perfuga* Speiser.

Subgenus *Ornithomyia,* proper

Ocelli present, either well developed or more or less reduced; but at least traces of one or more of them present. Prosternal lobes relatively short and wide, rather bluntly pointed.

The subgenus occurs in both the Old and the New World and comprises the majority of the species, which form two natural groups. The less evolved forms of the group of *O. avicularia* (Linnaeus, 1758) have the head broader than high, with large eyes, always distinct, functional ocelli, normal wings, rather short humeral callosities and a moderately hirsute body. This group contains also the two American species and the Australian *O. fuscipennis* Bigot (1885) (= *O. perfuga* Speiser, 1902). The group of *O. biloba* Dufour (1827), restricted to the Old World, is more specialized, with a lengthened, subcircular head, smaller eyes, ocelli reduced in size or more or less rudimentary, prominent humeral callosities, shorter and broader wings with more crowded veins, and a very hirsute body. Here belong also *O. fur* Schiner

(1868), *O. comosa* Austen (1930), *O. inocellata* Ferris (1930, with partly aborted ocelli) and an undescribed Australian species. The species of the *avicularia* group each breed on a variety of unrelated hosts, while those of the *biloba* group are all specific parasites of swallows (Hirundinidae).

Ornithomyia fringillina Curtis

Figs. 12*K*, 13*A*, 19, 20, 27, 28*A-L*, and 29*A-F*

Ornithomyia fringillina "A. Matthews, MS" Curtis, 1836, British Entomology, **8**, Pl. 585, colored fig. and figs. 2, 3, 4, 8; with letterpress (no sex. England: Weston on the Green near Oxford; on "yellow hammer" [*Emberiza c. citrinella*], "greater titmouse" [*Parus major newtoni*], and "robin" [*Erithacus rubecula melophilus*]; with references to "Curtis, Guide Gen. 1356.4"[30] and doubtfully to Degeer's Pl. 16, figs. 21–27. One ♀ type now at the Australian National Museum, Melbourne; others presumably lost). Thompson, 1936, Ent. Mo. Mag., **72**, p. 91 (notes on one of Curtis' types); 1936, Ann. Mag. Nat. Hist., (10), **18**, p. 310 (Martha's Vineyard, Massachusetts, on *Melospiza m. melodia*, with Mallophaga attached. Elmhurst, New York, on *Turdus m. migratorius*, with Mallophaga attached); 1937, *Op. cit.*, (10), **20**, p. 441 (Anticosti I., Quebec, on *Perisoreus c. canadensis*, with *Brüelia* attached. Vancouver, on *Hylocichla u. ustulata*, with *Brüelia interposita* attached. Spruce Brook, Newfoundland, on *Hylocichla f. fuscescens*, with *Brüelia* attached). Strickland, 1938, Canad. Jl. Res., Sect. D, **16**, p. 219 (Alberta: on *Penthestes h. hudsonicus, Hesperiphona v. vespertina, Picoides arcticus, Lanius ludovicianus excubitorides*, and several species of sparrows). Spencer, 1938, Proc. Ent. Soc. British Columbia, **34**, pp. 42–43 (British Columbia: Chezakut Lake, on *Larus delawarensis;* Lytton, on *Dendragapus obscurus richardsoni;* Lone Butte, possibly on *Dendragapus obscurus richardsoni;* Wentworth, on *Canachites franklinii;* Salmon Arm, on *Accipiter striatus velox;* Jesmond, on hawk; Pitt River, on *Glaucidium gnoma californicum;* Vancouver, on *Asio wilsonianus, Dendrocopos pubescens gairdnerii, Colaptes c. cafer, Junco o. oreganus, Melospiza melodia morphna, Melospiza lincolnii gracilis, Hedymeles m. melanocephalus, Vermivora celata lutescens, Passer d. domesticus, Hylocichla u. ustulata, Acridotheres c. cristatellus, Turdus migratorius propinquus,* and *Hylocichla g. guttata.* Infestation with mites. *Brüelia interposita* attached to a fly on *Hylocichla u. ustulata*). Procter, 1946, Biol. Surv. Mt. Desert, **7**, Insect Fauna, p. 437 (Maine: Mt. Desert). J. Bequaert and M. Leclercq, 1947, Bull. Ann. Soc. Ent. Belgique, **83**, pp. 81 and 83. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, p. 397, figs. 233, 235, and 237 (Illinois: Blue Island, on *Junco h. hyemalis, Melospiza g. georgiana, M. l. lincolnii,* and *Zonotrichia albicollis.* Michigan: McMillan, Luce Co., on *Spizella p. passerina, Molothrus a. ater,* and *Passerculus sandwichensis savanna;* Umadilla, Washburn Co., on *Richmondena c.*

[30] Bezzi and others date the trivial name *fringillina* by error from 1824, the year when Curtis started the publication of his "British Entomology;" but the letterpress to Pl. 585 is dated 1836. Curtis' reference is to the 2nd edition of his "Guide to an Arrangement of British Insects," Column 278 (1837); the name is not mentioned in the 1st Ed. (1829–1831).

cardinalis. Minnesota: without precise locality, on *Plectrophenax nivalis*. Wisconsin: without precise locality, on *Hylocichla guttata faxoni* and *Melospiza m. melodia;* Milwaukee Co., on *Zonotrichia albicollis* and *Richmondena c. cardinalis;* Cedar Grove, Sheboygan Co., on *Falco c. columbarius* and *Zonotrichia albicollis;* Lost Lake, Vilas Co., on *Melospiza g. georgiana;* Door Co.; Madison, Dane Co., on *Turdus m. migratorius*). J. Bequaert, 1950, Psyche, **57**, p. 113. de Buen, 1950, An. Inst. Biología, México, **21**, pt. 2, p. 416 (Mexico: Temamatla, 2200 m., 35 Kilom. S. E. of Mexico City, State of Mexico, on *Carpodacus m. mexicanus*). Eliz. Boyd, 1951, Jl. of Parasitology, **37**, p. 61 (New York State: on *Sturnus v. vulgaris*). Strickland, 1953, Canad. Jl. Zool., **31**, No. 3, p. 291 (ptilinum). Thompson, 1954, Ann. Mag. Nat. Hist., (12), **7**, p. 19, figs. 1, 2, 6, and 10 (redescription of one of Curtis' types).

Ornithomyia fringillaria Wood, 1872, Insects at Home, pp. 640 and 659, cut LXXVI, figs. 2 and 2*c–d* (error for *fringillina*). Clay and Meinertzhagen, 1943, Parasitology, **35**, pts. 1–2, p. 14 (Massachusetts: without precise locality, on *Turdus m. migratorius,* carrying 2 Mallophaga, *Philopterus* sp.).

Ornithomyia fringillae Bagnall, 1926, Vasculum, **12**, p. 80 (error for *fringillina*).

Ornithomya fringilla Owen, 1953, Entomologist's Record, **65**, p. 31 (error for *fringillina*).

Ornithomyia avicularia Leach, 1817, Gen. Spec. Eproboscideous Ins., pp. 7 and 15; Pl. 25, figs. 4–5 (common in France; in England on "*Tetrao tetrix*" [*Lyrurus tetrix britannicus*] and "*Alauda pipit*" [*Anthus pratensis*]; collected in December in "Danmonia Meridionali" [Devonshire]) [1818, Mem. Werner. Nat. Hist. Soc., Edinburgh, **2**, pp. 553 and 561; Pl. 25, figs. 4–5]. van der Wulp, 1869, Tijdschr. v. Entom., **12**, p. 80 (Wisconsin). Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 213. Howard, 1883, South Carolina, Resources and Population, p. 275. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654. Washburn, 1905, Univ. Minnesota, Agric. Expt. Sta., Bull. **93**, p. 163 (Minnesota: on *Junco h. hyemalis*). Speiser, 1907, Ent. News, **18**, p. 103. Coquillett, 1907, *Op. cit.*, **18**, p. 290. Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 199, figs. 15 and 16*A–B* (♀ ♂. State of Washington: Keyport. California: Pacific Grove, on *Sayornis s. saya.* Oregon: Upper Alsea River Valley, on *Cyanocitta stelleri frontalis*). McAtee, 1922, Ent. News, **33**, p. 90 (Oregon: Ontario, on *Corvus brachyrhynchos hesperis,* with Mallophagan attached. Saskatchewan: Macfarlane River, Lake Athabaska, with Mallophagan attached). Cole, 1923, Ent. News, **34**, p. 950. Falcoz, 1926, Faune de France, **14**, p. 25, figs. 37, 38, 41, and 42 (in part: figs. copied from Ferris and Cole, 1922). Ferris, 1927, Canad. Entom., **59**, p. 251 (California: Baldwin Lake, on *Myadestes townsendi;* La Honda, San Mateo Co., on *Glaucidium gnoma californicum.* British Columbia: Vancouver, on "tanager" and *Sturnus v. vulgaris*). Ewing, 1927, Ann. Ent. Soc. America, **20**, p. 247, fig. 1 (Ohio: Gates Mills, on *Melospiza m. melodia* and *Dumetella carolinensis,* in both cases with *Brüelia interposita* attached). Spencer, 1928, Canad. Entom., **60**, p. 257 (British Columbia: Tofino on Clayoquot Sound, on *Cyanocitta s. stelleri,* with *Brüelia deficiens* attached). Peters, 1933, Bird-Banding, **4**, p. 71 (New Hampshire: East Westmoreland, on *Sitta c. carolinensis, Seiurus n. noveboracensis, Geothlypis trichas brachidactyla, Spizella p. passerina, Melospiza g. georgiana,* and *Melospiza m. melodia;* Peterboro, on *Molothrus a. ater, Carpodacus p. purpureus, Junco h. hyemalis, Spizella p. passerina, Zonotrichia albicollis,* and *Melospiza m. melodia.* Massachusetts: Worcester, on *Dumetella carolinensis, Hylocichla f. fuscescens, Agelaius p. phoeniceus, Icterus galbula, Passerculus sandwichensis savanna, Zonotrichia albicollis,* and *Melospiza m. melodia;* Groton, on *Dumetella caro-*

linensis, Quiscalus q. quiscula, and *Melospiza m. melodia;* Oak Bluffs, on *Icterus galbula, Molothrus a. ater, Pipilo e. erythrophthalmus,* and *Melospiza m. melodia.* Vermont: Wells River, on *Zonotrichia albicollis* and *Dumetella carolinensis.* New York: Elmhurst, Long Island, on *Toxostoma r. rufum, Hylocichla f. fuscescens, Dendroica coronata,* and *Zonotrichia albicollis;* Mohonk Lake, on *Turdus m. migratorius, Piranga erythromelas, Pipilo e. erythrophthalmus, Junco h. hyemalis, Zonotrichia albicollis,* and *Melospiza m. melodia.* Ohio: Leetonia, on *Turdus m. migratorius, Melospiza m. melodia,* and *Spizella p. pusilla;* Gates Mills, on *Melospiza m. melodia;* Columbus, on *Melospiza m. melodia.* Michigan: McMillan, on *Molothrus a. ater, Passerculus sandwichensis savanna, Pooecetes g. gramineus,* and *Spizella p. passerina*). Eidmann, 1935, Arb. Morphol. Taxon. Entom., Berlin-Dahlem, **2**, p. 99 (Labrador: Upper Matamek River, 50° 17′ N., 65° 68′ W., on *Junco h. hyemalis,* August 22). Spencer, 1938, Proc. Ent. Soc. British Columbia, **34**, p. 42. Not of Linnaeus, 1758.

Ornithomyia aviculare Clay and Meinertzhagen, 1943, Parasitology, **35**, pts. 1–2, p. 12 (in part: specimens from North America previously reported as carrying Mallophaga). Error for *O. avicularia,* but not Linnaeus' species.

Ornithomyia pallida Say, 1823, Jl. Ac. Nat. Sci. Philadelphia, **3**, p. 103 (no sex; on *"Sylvia sialis"* [*Sialia s. sialis*]. United States, without precise locality. Type lost); 1837, Oeuvres Entomologiques, edit. by Gory, p. 103; 1859, Complete Writings, edit. by LeConte, **2**, p. 87. Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 610. Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1143 (Nova Scotia). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 159 (Mexico). Brodie and White, 1883, Check List Ins. Dom. Canada, p. 57. Howard, 1883, South Carolina, Resources and Population, p. 275. Johnson, 1900, 27th Ann. Rept. New Jersey State Bd. Agric., (for 1899), p. 699 (New Jersey: Delaware River, on *Dolichonyx oryzivorus* and *Agelaius p. phoeniceus*). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654. Not *O. pallida* Latreille, 1812, nor of v. Olfers, 1816.

Ornithomyia anchineuria Speiser, 1905, Zeitschr, Syst. Hym. Dipt., **5**, p. 348 (new name for *Ornithomyia pallida* Say, 1823); 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303. Johnson, 1910, Ann. Rept. New Jersey State Mus., (for 1909), p. 814; 1913, Bull. Amer. Mus. Nat. Hist., **32**, p. 90 (in list of Florida Diptera, but not actually taken there). Davis, 1922, Proc. Staten Island Inst. Arts Sci., **1**, p. 64 (New York: Yankee Lake, Wurtsboro, Sullivan Co., on *Geothlypis t. trichas;* Richmond, Staten Island, on *Thryothorus l. ludovicianus*). Johnson, 1922, Psyche, **29**, p. 81 (Pennsylvania: Clifton, on *Hylocichla guttata faxoni.* Massachusetts: Southbridge, on *Turdus m. migratorius;* Worthington, on *Dumetella carolinensis;* Essex, on *Passerculus sandwichensis savanna.* Vermont: Woodstock, on *Junco h. hyemalis.* Quebec: Ellis Bay, Anticosti I., on *Perisoreus c. canadensis* [as *"P. barbouri"*], with Mallophaga attached. Ontario: North Bay, on *Loxia curvirostra pusilla*); 1925, Occ. Papers Boston Soc. Nat. Hist., **7**, p. 293 (Maine: Bar Harbor. New Hampshire: Peterboro, on *Melospiza m. melodia.* Vermont: Chittenden, on *Spizella p. passerina.* Massachusetts: Chilmark, on *Melospiza m. melodia*); 1925, Bull. Northeastern Bird-Banding Assoc., **1**, p. 52; 1929, *Op. cit.,* **5**, p. 49 (Massachusetts: Rock, on *Spizella p. passerina;* Concord, on *Melospiza m. melodia;* Martha's Vineyard, on *Melospiza m. melodia* and *Pipilo e. erythrophthalmus;* Athol, on *Carpodacus p. purpureus;* Wellesley, on *Hedymeles ludovicianus;* Needham, on *Molothrus a. ater;* Holbrook, on *Toxostoma r. rufum.* New Hampshire: Peterboro, on *Spizella p. passerina* and *Dendrocopos pubescens*

medianus. Vermont: Wells River, on *Spizella p. passerina* and *Melospiza m. melodia*. Maine: Soldier Pond, on *Junco h. hyemalis*. Pennsylvania: Philadelphia, on *Dolichonyx oryzivorus* and *Agelaius p. phoeniceus* [evidently the same specimens as his Delaware River, New Jersey, records of 1900]; 1930, Publ. Nantucket M. Mitchell Assoc., **3**, No. 2, p. 158 (in Nantucket list, but not actually taken there). Peters, 1936, Bird-Banding, **7**, pp. 14, 19, 20, 21, 22, 23, 24, 25, 26, and 27 (Maine: on *Junco h. hyemalis*. New Hampshire: on *Dendrocopos pubescens medianus, Sitta c. carolinensis, Dumetella carolinensis, Turdus m. migratorius, Hylocichla f. fuscescens, Siala s. sialis, Seiurus n. noveboracensis, Geothlypis trichas brachidactyla, Molothrus a. ater, Carpodacus p. purpureus, Junco h. hyemalis, Spizella p. passerina, Zonotrichia albicollis, Melospiza l. lincolnii, Melospiza g. georgiana*, and *Melospiza m. melodia*. Vermont: on *Dumetella carolinensis, Passerculus sandwichensis savanna*, and *Zonotrichia albicollis*. Massachusetts: on *Dumetella carolinensis, Turdus m. migratorius, Quiscalus q. quiscula, Molothrus a. ater, Carpodacus p. purpureus, Hedymeles ludovicianus, Passerculus sandwichensis savanna, Spizella p. passerina, Zonotrichia albicollis*, and *Melospiza m. melodia*. Connecticut: on *Dumetella carolinensis, Hylocichla f. fuscescens, Agelaius p. phoeniceus, Icterus galbula, Passerculus sandwichensis savanna*, and *Melospiza m. melodia*. New York: on *Dumetella carolinensis, Toxostoma r. rufum, Turdus m. migratorius, Hylocichla guttata faxoni, Hylocichla ustulata swainsoni, Hylocichla f. fuscescens, Dendroica coronata, Piranga erythromelas, Pipilo e. erythrophthalmus, Junco h. hyemalis, Zonotrichia albicollis*, and *Melospiza m. melodia*. Pennsylvania: on *Colinus v. virginianus*. Maryland: on *Wilsonia citrina* and *Zonotrichia albicollis*. Ohio: on *Turdus m. migratorius, Molothrus a. ater, Richmondena c. cardinalis, Spizella p. pusilla*, and *Melospiza m. melodia*. Michigan: on *Molothrus a. ater, Passerculus sandwichensis savanna, Pooecetes g. gramineus*, and *Spizella p. passerina*). Herman, 1937, Bird-Banding, **8**, pp. 127 and 163 (Massachusetts: North Eastham, on *Molothrus a. ater*, with Mallophaga attached, and on *Circus cyaneus hudsonius, Tyrannus tyrannus, Penthestes a. atricapillus, Dumetella carolinensis, Turdus m. migratorius, Siala s. sialis, Dendroica a. aestiva, Dendroica p. pinus, Geothlypis trichas brachidactyla, Agelaius p. phoeniceus, Pipilo e. erythrophthalmus, Passerculus sandwichensis savanna, Ammodramus savannarum australis, Pooecetes g. gramineus, Spizella p. passerina, Spizella p. pusilla*, and *Melospiza m. melodia*. Infestation with mites). Procter, 1938, Biol. Surv. Mt. Desert, **6**, Insect Fauna, p. 378 (Maine: Bar Harbor). Herman, 1945, California Fish Game, **31**, p. 22, figs. 11*A–B* (puparium). Procter, 1946, Biol. Surv. Mt. Desert, **7**, Insect Fauna, p. 437. Thompson, 1947, Ent. Mo. Mag., **83**, p. 212.

Ornithomyia anchineura Coquillett, 1907, Ent. News, **18**, p. 290 (error for *anchineuria;* from Washington, D. C. to California). Cole and Lovett, 1921, Proc. California Ac. Sci., (4), **11**, p. 344 (Oregon: Upper Alsea Valley, Benton Co., on *Cyanocitta stelleri frontalis*). Johannsen, 1928, in Leonard, Cornell Univ. Agric. Expt. Sta., Mem. **101**, (for 1926), p. 868 (New York: Port Jefferson, Long Island, on *Toxostoma r. rufum*). Beer, 1944, Jl. Wildlife Manag., **8**, p. 91 (State of Washington: Okanogan Co., on *Dendragapus obscurus richardsoni*).

Ornithomyia avicularia anchineuria Eichler, 1937, Mitt. Ver. Sächsischer Ornith., **5**, pt. 3, p. 129.

Ornithomyia chloropus Bergroth, 1901, Medd. Soc. Fauna Flora Fennica, **26**, p. 146 (no sex. Finland: Tammela in southern Fennia, 2 cotypes on "*Asio accipitrinus* Pallas" [*Asio f. flammeus*]. Present location of types unknown). Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 33 (St. Pierre-and-Miquelon). Stackelberg, 1933, Tabl. Anal. Faune URSS, No. **7**, Mouches Partie Européenne de l'URSS, p. 481.

Ornithomyia lagopodis Sharp, 1907, Ent. Mo. Mag., **43**, p. 59 (♀ ♂. Scotland: Nethy Bridge, Inverness-shire; Boat O'Garten; Caithness; Blair Atholl, North Perthshire; all on *Lagopus scoticus.* Also Norway, on "*Lagopus albus*" [*Lagopus lagopus*]; "will bite human beings." Two ♀ ♀ from Caithness at Brit. Mus. are marked as "types"). Shipley, 1909, Proc. Zool. Soc. London, pp. 321–322; Pl. 43, figs. 21*A–B;* Pl. 44, figs. 22–25 (♀ ♂, puparium).

Ornithomyia lagapodis S. Smith, 1950, The Yellow Wagtail, p. 149 (error for *lagopodis*).

Ornithomyia sp. Elliott and Dearness, 1899, 29th Rept. Ent. Soc. Ontario, (for 1898), p. 60, figs. 33–34 (Ontario: Bryanton, on *Zonotrichia albicollis.* Puparium). Banks, 1920, Psyche, **27**, p. 20 (Anticosti I., Quebec, with Mallophaga attached).

Although *Ornithomyia fringillarum* Stadler (1948) was no doubt an error for *O. fringillina,* the author applied the name to specimens of *O. biloba* Dufour, from swallows, and it should be listed in the synonymy of that species.

Distribution and Specimens Examined. Alaska: Crater Mt., 62° 48′ N., 156° 49′ W., on *Surnia ulula caparoch,* Aug. 20, and *Falco columbarius bendirei,* Aug. 12 (A.H. Twitchell); Takotna, 63° N., 156° W., on *Canachites c. canadensis,* Oct. 1 (A.H. Twitchell); Nelchina River, near Mt. Witherspoon, N.W. of Valdez, 61° 30′ to 62° N., 147° W., Aug. 26 (R.B. Williams); 10 miles W. of Paxson, about 63° N., 146° W., on *Anthus spinoletta rubescens,* Sept. 7, 1952 (G.D. Gill); Fairbanks, 64° 59′ N., 148° 10′ W., 3 flies on *Bonasa umbellus yukonensis,* June 19 (Arctic Aëromedical Lab.).

Dominion of Canada. Alberta (recorded by Strickland, 1938): Ft. Chipewyan, Athabaska Delta (F. Harper); Belvedere, on *Penthestes h. hudsonicus, Zonotrichia leucophrys gambelii, Picoides arcticus, Turdus m. migratorius,* and *Hesperiphona v. vespertina* (C.G. Harrold); Edmonton, on *Lanius ludovicianus excubitorides* (E.H. Strickland); Tilley (R.W. Salt); Red Deer River, on *Turdus m. migratorius.* — British Columbia (recorded by Ferris, 1927; Spencer, 1928, 1938; Thompson, 1937): Vancouver, on *Colaptes c. cafer, Melospiza lincolnii gracilis, Vermivora celata lutescens, Acridotheres c. cristatellus, Hylocichla u. ustulata* (carrying 4 ♀ and one immature Mallophaga), *Turdus migratorius propinquus, Melospiza melodia morphna, Dendrocopos pubescens gairdnerii, Passer d. domesticus, Hylocichla g. guttata, Hedymeles m. melanocephalus,* and *Junco o. oreganus* (R.A. Cumming), and on *Piranga ludoviciana;* Kamloops, on *Dendragapus obscurus fuliginosus* (E.R. Buckell); Quesnel, on *Accipiter cooperii* (J. Grant); probably Vancouver, on *Asio wilsonianus,* Feb., newly-emerged fly carrying about its puparium (K. Racey); Chezakut Lake, on *Larus delawarensis* (R.A. Cumming); Trinity Valley, on *Canachites franklinii* (J. Grant); Upper Pitt River, on *Glaucidium gnoma californicum* (R.A. Cumming); Turner Valley, on *Falco s.*

sparverius and *Bonasa umbellus togata* (J. Grant); Wentworth, on *Canachites franklinii* (K. Racey); Lytton, on *Dendragapus obscurus richardsoni* (J.A. Munro), *Bonasa umbellus umbelloides* (A. Brooks), and *Hesperiphona vespertina brooksi;* McLeese Lake, July 7, 3 ♂ on *Sphyrapicus varius ruber* (T.R. Howell); Quinsam Lake, Vancouver I., on *Dendragapus obscurus fuliginosus* and *Zonotrichia leucophrys pugetensis* (J.S.F. Bendell); Barriere, on *Dendragapus obscurus richardsoni* (L. Proulx); Grindrod, in house, March 15, and on 2 *Loxia curvirostra bendirei, Dendrocopos pubescens leucurus, Falco s. sparverius, Molothrus ater artemisiae,* and *Piranga ludoviciana* (J. Wynne); Alta Lake, on *Zonotrichia albicollis* (I.McT. Cowan); Okanagan Landing, on *Hesperiphona vespertina brooksi,* Sept. 15 (F.C. Bishopp); Horse Lake, Lone Butte (W.R.W.); Salmon Arm, on *Accipiter striatus velox* (E.R. Buckell); Deadman's Creek, on *Lagopus l. lagopus* (= *albus*) (J. Grant); Bridge Lake, Bridge Creek, on *Canachites franklinii,* Oct. 13 (P. Martin). — Labrador (recorded by Eidmann, 1935): Goose Bay, 53° 20′ N., 60° 20′ W., Sept. 26 (R. Traub). — Newfoundland (recorded by Thompson, 1937): Spruce Brook, on *Hylocichla ustulata swainsoni,* Sept., and *Hylocichla f. fuscescens,* Sept., the latter with a Mallophagan attached (G.K. Noble). — Nova Scotia (recorded by Walker, 1849): without precise locality (Redman); Wolfville, on *Spizella p. passerina,* Sept. 11, and *Junco h. hyemalis* (R.W. Tufts). — Ontario (recorded by Elliott and Dearness, 1899; Johnson, 1922, 1929): Macdiarmid, Lake Nipigon, on *Vermivora peregrina* (N.K. Bigelow); Roebuck, on *Turdus m. migratorius* (G.H. Hammond); Smoky Falls near Kapuskasing, on *Carpodacus p. purpureus* and *Zonotrichia albicollis* (R.V. Whelan); Murillo, on *Molothrus a. ater* (T.M. Shortt); Ottawa, on *Melospiza m. melodia* (R.E. DeLong); Brulé Point, 4 flies on a nestling of *Hesperiphona v. vespertina* (C.H.D. Clarke); North Bay, on *Loxia curvirostra pusilla,* Sept. 7 (G.S. Miller, Jr.); Pancake Bay, Algoma District, on *Bubo v. virginianus, Melospiza m. melodia,* and 3 *Hesperiphona v. vespertina* (G.H.D. Clarke); Brulé Lake, Algonquin Park, on *Zonotrichia albicollis, Hesperiphona v. vespertina, Euphagus carolinus, Sphyrapicus v. varius,* and *Picoides arcticus* (G.H.D. Clarke); Pointe Pelée, on *Philohela minor* (A.W. Andrews); Agawa Bay, Lake Superior, on *Penthestes h. hudsonicus* and *Melospiza m. melodia* (W.G. Fargo); Toronto, on *Zonotrichia albicollis, Dendroica tigrina, Dendroica castanea, Toxostoma r. rufum,* and *Passer d. domesticus* (R.S. Baker); Lake of Two Rivers, Algonquin Park, on *Melospiza m. melodia,* with

Mallophagan attached, *Zonotrichia albicollis,* and *Spizella p. passerina* (D.M. Davies); Lake Sasajewan, Algonquin Park, on *Melospiza m. melodia* and *Zonotrichia albicollis* (D.M. Davies). — Quebec (recorded by Banks, 1920; Johnson, 1922, 1929; Thompson, 1937): Ellis Bay, Anticosti I., Sept. 3, on *Perisoreus c. canadensis,* with two Mallophaga (*Brüelia* sp.) attached (W.S. Brooks. — Case reported by N. Banks, 1920); St. Anne's, on *Molothrus a. ater* (W. E. Whitehead); Montebello, on *Megaceryle a. alcyon* (W.E. Whitehead); Joliette, on *Pandion haliaetus carolinensis* (J. Ouellet); Chateauguay River, on *Philohela minor,* Sept. 22 (Lionel Philippe). — Saskatchewan (recorded by McAtee, 1922): Macrorie, on *Molothrus a. ater, Turdus m. migratorius,* and *Agelaius p. phoeniceus* (F.J.H. Fredeen); Poplar Point, Lake Athabaska (F. Harper); mouth of Macfarlane River, Lake Athabaska, bearing a Mallophagan, *Brüelia rotundata* (F. Harper); Lobstick I., Lake Athabaska, Aug. 20 (F. Harper); Island 1 mile E. of Crackingstone Pt., Lake Athabaska, Aug. 17 (F. Harper). — Yukon: Timber Creek, a tributary of the Old Crow River, up river from Black Fox Creek, about 68° N., 140° W., July 30 (O.J. Murie).

St. Pierre-and-Miquelon (recorded by Falcoz, 1930): specimen at Paris Museum (Baron, 1890).

United States. Arizona: Betatakin Beko, N.W. of Kayenta, Navajo Co., 7000 ft. on *Junco mearnsi* (A.R. Phillips); Cassadore Spring, 15 miles N. of San Carlos, Gila Co., on *Otus asio mccallii* (A.R. Phillips). — California (recorded by Ferris and Cole, 1922; Ferris, 1927): Berkeley, Alameda Co., on *Pipilo maculatus falcifer* (E.L. Sumner; H.E. Childs, Jr., Aug. 28, fly with Mallophagan attached; B.F. Brown, Aug. 30; and O.E. Sousa), on *Melospiza melodia gouldii* (O.E. Sousa; S.K. Carnie, Oct. 6), on *Zonotrichia leucophrys nuttalli* (H.E. Childs, Jr.), on *Carpodacus mexicanus frontalis* (I.B. Tarshis), on *Zonotrichia coronata,* Oct. 12, with Mallophagan attached, *Passerella iliaca* subsp., Nov. 15, and *Aphelocoma c. californica,* Nov. 1 (S.K. Carnie), on *Pipilo fuscus petulans* (H.E. Childs, Jr., 1 fly; O.E. Sousa, 2 flies, one with Mallophagan attached), and on *Baeolophus i. inornatus* (D.W. Johnston); San Francisco, on *Zonotrichia leucophrys nuttalli* (McGregor), and on *Falco s. sparverius* and *Thryomanes bewickii spilurus* (G.D. Hanna); Carmel, Monterey Co., on *Zonotrichia coronata* (L.O. Williams); Pacific Grove, Monterey Co., on *Penthestes rufescens barlowi,* Dec. 28 (A.K. Fisher) and on *Sayornis s. saya;* La Honda, San Mateo Co., on *Glaucidium gnoma californicum;* Baldwin Lake, San Bernardino Co., on *Myadestes townsendi;* Mill Valley, Marin

Co. (E.S. Ross); Woodacre, Marin Co., on *Zonotrichia coronata,* two flies with Mallophaga (*Brüelia* sp.) attached (J. Maillard); Hastings Reservation near Jamesburg, Monterey Co., on *Zonotrichia coronata* (J.M. Linsdale). — COLORADO: Steamboat Springs, Routt Co., on *Icteria virens longicauda* (O. Briant). — CONNECTICUT (recorded by Peters, 1936): Waterford, New London Co. (P. Crowe); Pomfret, Windham Co., on *Hylocichla f. fuscescens,* Aug. 3, *Melospiza m. melodia,* July 3, *Icterus galbula,* July 24, and *Agelaius p. phoeniceus,* Aug. 3 (F.C. Bishopp). — DISTRICT OF COLUMBIA: on *Toxostoma r. rufum,* Oct. 14 (T. Pergande) and on *Cyanocitta c. cristata,* July 18 (J.C. Bridwell). — ILLINOIS (recorded by MacArthur, 1948): Waukegan, Lake Co., on *Zonotrichia albicollis* (W.I. Lyon); Blue Island, Cook Co., on 2 *Junco h. hyemalis,* Oct. 15 and 27, *Melospiza l. lincolnii,* Oct. 10, *Zonotrichia albicollis,* Oct. 20, and *Melospiza g. georgiana,* Oct. 13 (K.E. Bartel). — IOWA: Ames, Story Co., Oct. 18, on a person who handled a live, native species of sparrow (J.L. Krall). — MAINE (recorded by Johnson, 1925, 1929; Peters, 1936; Procter, 1938, 1946): Northeast Harbor, Hancock Co., on *Carpodacus p. purpureus* (H.E. Bailey); Bar Harbor, Hancock Co. (B. Moore); Mt. Desert Island, Hancock Co., on *Hylocichla guttata faxoni,* with two Mallophaga attached, July 29 (A.E. Brower); Soldier Pond, Aroostook Co., on *Junco h. hyemalis,* Sept. 28 (E.O. Grant). — MARYLAND (recorded by Peters, 1936): Laurel, Prince Georges Co., on *Wilsonia citrina,* July 21 (E.B. Marshall); Beltsville, Prince Georges Co., on *Melospiza m. melodia,* July 8, *Turdus m. migratorius,* July 23, and *Spizella p. passerina,* June 28 (F.R. Smith); Patuxent Research Refuge, Bowie, Prince Georges Co., on *Melospiza l. lincolnii* (R.T. Mitchell). — MASSACHUSETTS (recorded by Johnson, 1922, 1925, 1929; Peters, 1933, 1936; Thompson, 1936; Herman, 1937; Clay and Meinertzhagen, 1943): North Eastham, Barnstable Co., on *Circus cyaneus hudsonius, Tyrannus tyrannus, Penthestes a. atricapillus, Dumetella carolinensis, Turdus m. migratorius, Sialia s. sialis, Dendroica a. aestiva, Dendroica p. pinus, Geothlypis trichas brachidactyla, Agelaius p. phoeniceus, Molothrus a. ater,* Oct. 3, *Pipilo e. erythrophthalmus, Passerculus sandwichensis savanna,* Oct. 18, *Ammodramus savannarum australis, Pooecetes g. gramineus, Spizella p. passerina, Spizella p. pusilla,* and *Melospiza m. melodia,* Nov. 6 (C.M. Herman); Sagamore Beach, Barnstable Co., on *Toxostoma r. rufum* (H.S. Fuller); Groton, Middlesex Co., on *Turdus m. migratorius, Dumetella carolinensis, Passerculus sandwichensis savanna, Hylocichla f. fuscescens, Zonotrichia albicollis,*

Spizella p. passerina, Oct. 15, *Penthestes a. atricapillus, Mniotilta varia,* and *Melospiza m. melodia* (W.P. Wharton); Oak Bluffs, Martha's Vineyard, on *Agelaius p. phoeniceus, Melospiza m. melodia,* with Mallophagan (*Brüelia* sp.) attached, *Molothrus a. ater, Pipilo e. erythrophthalmus,* and *Vermivora r. ruficapilla* (S. Harris and G.C. Eustis), on *Dumetella carolinensis* (M.M. Cole), and on *Spizella p. passerina,* with Mallophagan (*Brüelia* sp.) attached (F.C. Bishopp); Rock, Littleboro, Plymouth Co., on *Melospiza m. melodia, Vermivora r. ruficapilla* and *Spizella p. passerina* (A.W. Higgins); Cohasset, Norfolk Co., on *Spizella p. passerina* (L.B. Fletcher) and *Melospiza m. melodia* (C.L. Whittle); Essex, Essex Co., on *Passerculus sandwichensis savanna* (A.B. Fuller); Worthington, Hampshire Co., on *Dumetella carolinensis* (Niles); Auburndale, Middlesex Co., on *Cyanocitta c. cristata* (C.B. Floyd); Southbridge, Worcester Co., on *Turdus m. migratorius* (S.W. Bromley); Salem, Essex Co., on *Accipiter cooperii,* Oct. 5 (R.P. Dow); Milton, Norfolk Co., on *Quiscalus quiscula aeneus* (R.M. Hinchman); Hadley, Hampshire Co., on *Melospiza l. lincolnii* (J. Baird); Topsfield, Essex Co., on *Spizella a. arborea* (S.K. Harris); Chilmark, Dukes Co., on *Melospiza m. melodia* (S.K. Harris); Concord, Middlesex Co., on *Melospiza m. melodia* (F.B. White; W.E. Schevill); Athol, Worcester Co., on *Carpodacus p. purpureus* (R. Allison); Wellesley, Norfolk Co., on *Hedymeles ludovicianus* (Mrs. H.C. Dunham); Needham, Norfolk Co., on *Molothrus a. ater* (J.D. Smith); Holbrook, Norfolk Co., on *Toxostoma r. rufum* (J.D. Smith); Old Deerfield, Franklin Co., on *Molothrus a. ater* and *Melospiza m. melodia* (Miss Marion E. Smith); Hudson, Middlesex Co. (C.W. Johnson). — MICHIGAN (recorded by Peters, 1933, 1936; MacArthur, 1948): 1 mile S. of Umadilla, Washtenaw Co., on *Richmondena c. cardinalis* (Camburn and Sutton); McMillan, Luce Co., on *Pooecetes g. gramineus, Quiscalus quiscula aeneus,* 2 *Molothrus a. ater,* July 28 and Aug. 3, *Spizella p. passerina,* July 29, and *Passerculus sandwichensis savanna,* July 23 (O.M. Bryens). — MINNESOTA (recorded by Lugger, 1897; Washburn, 1905; MacArthur, 1948): Pine Co., on *Bonasa u. umbellus* (R.E. Schumacher); Grand Rapids, Itasca Co., on *Junco h. hyemalis;* Hennepin Co. — MONTANA: Bridger Mts., Carbon Co., on *Dendragapus obscurus richardsoni,* Sept. 24 (H.B. Mills); East Fork, Ravalli Co., on *Phasianus colchicus* (J. Brennan); Harlan Gulch, Ravalli Co., on *Bonasa umbellus umbelloides,* Oct. 8, and *Dendragapus obscurus richardsoni,* Aug. 10 (W.L. Jellison); Goat Mountain, Ravalli Co., on *Dendragapus obscurus richardsoni,* Sept. 18 (C.B. Philip);

Beaverhead Co., on *Canachites c. canadensis* (C.B. Philip and W.L. Jellison); Darby, Ravalli Co., on *Cyanocitta c. cristata,* Sept. 2 (V. Bailey); Fisher River, 25 miles S. of Libby, Lincoln Co., on *Bonasa umbellus umbelloides* (Lowell Adams); Bozeman, Gallatin Co., Oct. 8 (C.B. Philip). — New Hampshire (recorded by Johnson, 1925, 1929; Peters, 1933, 1936): East Westmoreland, Cheshire Co., on 2 *Spizella p. passerina,* Aug. 21 and 27, *Siala s. sialis, Hylocichla f. fuscescens, Geothlypis t. trichas,* Aug. 24, *Geothlypis trichas brachidactyla, Turdus m. migratorius, Melospiza l. lincolnii, Melospiza g. georgiana,* and *Melospiza m. melodia* (L.O. Shelley); Ashland, Grafton Co., on *Melospiza m. melodia* (Mrs. R.B. Harding); Peterboro, Hillsboro Co., on 2 *Melospiza m. melodia,* Aug. 26 and Sept., *Zonotrichia albicollis, Junco h. hyemalis, Carpodacus p. purpureus, Spizella p. passerina,* and *Dendrocopos pubescens medianus* (Mrs. C.L. Whittle). — New Jersey (recorded by Johnson, 1900, 1910): Ridgewood, Bergen Co., on hawk (H. Hales); Tenafly, Bergen Co., on *Melospiza m. melodia* (Mrs. H. Carnes); Demarest, Bergen Co., on *Turdus m. migratorius, Cyanocitta c. cristata, Dumetella carolinensis, Molothrus a. ater, Piranga erythromelas, Hylocichla mustelina, Hylocichla f. fuscescens, Seiurus a. aurocapillus, Hedymeles ludovicianus, Icterus galbula, Sitta c. carolinensis, Toxostoma r. rufum, Baeolophus bicolor, Dendroica c. coronata, Zonotrichia albicollis, Vermivora pinus, Quiscalus quiscula aeneus, Troglodytes a. aëdon, Setophaga ruticilla, Geothlypis trichas brachidactyla, Melospiza m. melodia,* and *Pipilo e. erythrophthalmus* (B.S. Bowdish; some of these with Mallophaga, as listed in Part I, p. 170); Pequannock, Morris Co., on *Quiscalus q. quiscula* (Mrs. M. Dumont); Stag Lake, Sussex Co., on *Accipiter striatus velox,* Oct. (W.J. McAtee). — New Mexico: Rio Arriba Co., on chicadee (*Penthestes* sp.), nuthatch (*Sitta* sp.) and titmouse (*Baeolophus* sp.) (L.D. Compton); Upper Pecos River, San Miguel Co., on *Dendragapus o. obscurus* (through L. Lee). — New York (recorded by Davis, 1922; Johannsen, 1928; Peters, 1933, 1936; Thompson, 1936; Boyd, 1951): Delmar, Albany Co., on *Sturnus v. vulgaris,* Oct. 26, *Molothrus a. ater,* July 25, and *Turdus m. migratorius,* July 13 (F.C. Goble); Mohonk Lake, Ulster Co., on *Melospiza m. melodia, Junco h. hyemalis, Zonotrichia albicollis, Turdus m. migratorius,* and *Pipilo e. erythrophthalmus* (D. Smiley, Jr.); Richmond, Staten Island, on *Thryothorus l. ludovicianus* (J.P. Chapin); Orient, Long Island, on *Pipilo e. erythrophthalmus,* June 4 (R. Latham); Elmira, Tompkins Co., on *Sturnus v. vulgaris* (Elizabeth M. Boyd); White Plains, Westchester Co., on *Zono-*

trichia albicollis (C. Farley); Syracuse, Onondaga Co., on *Spizella p. passerina* (R.D. Manwell); Babylon, Long Island (Blanton and Bordera); Port Jefferson, Long Island, on *Toxostoma r. rufum,* July (R.C. Murphy); Elmhurst, Long Island, on *Sitta c. carolinensis, Compsothlypis americana pusilla, Seiurus a. aurocapillus, Zonotrichia albicollis, Turdus m. migratorius, Hylocichla guttata faxoni, Hylocichla ustulata swainsoni, Hylocichla f. fuscescens, Melospiza g. georgiana, Junco h. hyemalis, Geothlypis trichas brachidactyla, Dendroica c. coronata,* and *Toxostoma r. rufum* (Marie V. Beals); Yankee Lake, Wurtsboro, Sullivan Co., on *Geothlypis t. trichas* (J.P. Chapin); Macedon, Wayne Co., on *Colaptes auratus luteus* (J.D. Hood). — North Dakota: Fargo, Cass Co., on *Melospiza l. lincolnii* (O.A. Stevens). — Ohio (recorded by Ewing, 1927; Peters, 1933, 1936): Columbus, Franklin Co., on *Turdus m. migratorius* and *Richmondena c. cardinalis* (E.S. Thomas), and on *Zonotrichia albicollis* (W. Jones); Leetonia, Columbiana Co., on *Turdus m. migratorius* and *Spizella p. pusilla;* Gates Mills, Cuyahoga Co., on *Molothrus a. ater, Melospiza m. melodia,* and *Dumetella carolinensis* (R. Boulton). — Oregon (recorded by McAtee, 1922; Cole and Lovett, 1921; Ferris and Cole, 1922): without precise locality, on *Colaptes c. cafer;* Ontario, Malheur Co., on *Corvus brachyrhynchos hesperis* (E.R. Kalmbach); Upper Alsea River Valley, Benton Co., on *Cyanocitta stelleri frontalis* (F.R. Cole and A.L. Lovett); 2 miles E. of Union Creek Junction (West slope of Cascade Mts.), 400 ft., Jackson Co., on *Turdus migratorius propinquus* (D.S. Farner); Tillamook, Tillamook Co., on *Sphyrapicus varius ruber,* Dec. 1, and *Carpodacus purpureus californicus,* Aug. 31 (A. Walker); Blaine, Tillamook Co., on *Glaucidium gnoma californicum* (A. Walker); Adel, Lake Co., on *Myadestes townsendi,* Oct. 18 (A. Walker); Netarts, Tillamook Co., on *Junco oreganus shufeldti,* Dec. 1, *Melospiza melodia morphna,* Oct. 18, and *Dendrocopos villosus harrisi,* June 25 (A. Walker); Nehalem, Tillamook Co., on chicken hawk (H.E. Henderson); Euchre Mt., 7 miles N.E. of Siletz, Lincoln Co., on *Cathartes aura teter,* 1 ♀ fly with 4 *Brüelia* sp. attached (Roy Wing); Corvallis, Benton Co., on *Dendrocopos villosus harrisi;* Boyer, 9 flies on *Glaucidium gnoma californicum,* Aug. 16 (J. A. Macnab). — Pennsylvania (recorded by Johnson, 1922, 1929; Peters, 1936): College Station, Easton, Northampton Co., on *Icterus galbula* (Merrill Wood); Philadelphia Neck, South Philadelphia, on 3 *Agelaius p. phoeniceus,* Aug. 19 and 26, and Oct. 18, and 3 *Dolichonyx oryzivorus,* Sept. 2, 11 and 27 (C. Liebeck); Fredericktown, Washington Co., on *Mo-*

lothrus a. ater, July 4, and *Troglodytes a. aëdon,* July 9; Point Pleasant, Bucks Co., on *Richmondena c. cardinalis;* Harrisburg, Dauphin Co., on *Hylocichla mustelina* (H.B. Wood); Delaware Co., on *Hylocichla guttata faxoni,* Oct. 19, and *Agelaius p. phoeniceus;* York Co., on migrating juvenile *Richmondena c. cardinalis,* Sept. 15 (H.M. Martin); Wilkinsburg, Allegheny Co., on *Turdus m. migratorius* (A.D. Kirk); Forest Hill Borough, Pittsburgh, on *Hylocichla mustelina,* said to have carried a Mallophagan which was lost (A.D. Kirk); Beaver, Beaver Co., on *Helmitheros vermivorus,* Aug. 17 (W.E.C. Todd); Blairsville, Indiana Co., on *Colinus v. virginianus,* June 23 (F.C. Bishopp); Norwood, Delaware Co., on *Dolichonyx oryzivorus,* Sept. 14 (C. Liebeck); Moores, Delaware Co., on *Agelaius p. phoeniceus,* Oct. 13 (C. Liebeck). — South Dakota: Brookings, Brookings Co. (J.M. Aldrich). — Tennessee: Nashville, Davidson Co., on *Pipilo e. erythrophthalmus,* June 20 (A.R. Laskey). — Texas: El Paso, El Paso Co. — Utah: Hyde Park, Cache Co., on *Colaptes cafer collaris* (G.F. Knowlton and G.S. Stains); Logan, Cache Co. on *Sphyrapicus varius nuchalis* (G.F. Knowlton, G.S. Stains and F.C. Harmston). — Vermont (recorded by Johnson, 1922, 1925, 1929; Peters, 1933, 1936): Barre, Washington Co., on *Dendrocopos v. villosus, Dendrocopos pubescens medianus, Melospiza m. melodia,* and *Cyanocitta c. cristata* (Mrs. H.A. Drew); Wells River, Orange Co., on *Melospiza m. melodia, Spizella p. passerina, Turdus m. migratorius,* Aug. 4, and *Dumetella carolinensis,* Aug. 2 (W. R. Smith); Chittenden, near Rutland, Rutland Co., on *Spizella p. passerina,* Aug. 15 (J. Bequaert); Woodstock, Windsor Co., on *Junco h. hyemalis* (A.P. Morse). — Washington (State) (recorded by Ferris and Cole, 1922; Beer, 1944): Pullman, Whitman Co., on *Zonotrichia leucophrys gambelii,* Sept. 18 (O. Farner and R. Mewaldt); Keyport, Kitsap Co.; Colville, Stevens Co., on *Junco o. oreganus,* Aug. 21 (C.M. Gjullin; A. Walker); Puyallup, Pierce Co. (C.W. Getzendaner); Conconally, Okanogan Co., on *Dendragapus obscurus richardsoni* (J. Beer); Winthrop, Okanogan Co., on *Dendragapus obscurus richardsoni* (Mrs. Dorothy Schottelius); Twin Buttes, on *Turdus migratorius propinquus,* July 20 (F.C. Bishopp); Kelso, Cowlitz Co., on *Bonasa umbellus togata* (P. Shepardson). — Wisconsin (recorded by van der Wulp, 1869; Peters, 1936; MacArthur, 1948): Madison, Dane Co., on *Turdus m. migratorius,* Aug. 8 (J. Beer), and on *Zonotrichia albicollis,* Oct. 12 (P. Hickey and W.J. Woodman); Cedar Grove, Sheboygan Co., on *Falco c. columbarius,* Oct. 10, and *Zonotrichia albicollis,* Oct. 5 (L. Diederich);

Milwaukee, Milwaukee Co., on *Zonotrichia albicollis* (A.L. Throne); Milwaukee Co., on *Richmondena c. cardinalis,* Sept. 15, and on *Zonotrichia albicollis,* Sept. 28 (P.W. Hoffman); Lost Lake, Eagle River, Vilas Co., on *Melospiza g. georgiana,* Aug. (A.L. Throne); Wausau, Marathon Co., on *Colaptes cafer collaris,* Sept. 27 (H.W. Levi); Door Co., July 29 (J.H. Roberts); going north toward Peshtigo, Oronto Co., alighting on Man, without attempting to bite, 45° N., June 26 (D.W. Paxson). — Wyoming: Two-Ocean Lake Road, Teton Co., on *Zonotrichia leucophrys gambelii* (N.A. Meinkoth); Jackson Hole Wildlife Park, Teton Co., on *Bonasa umbellus umbelloides* (N.A. Meinkoth).

Mexico (recorded by Rondani?, 1878; de Buen, 1950):[31] Mexico City, on "gonión chico" (possibly *Carpodacus m. mexicanus*) (Esc. N.C.Biol.); Cerro Tancitaro, Munic. Tancitaro, State of Michoacan, 7800 ft., on *Turdus migratorius* subsp. (R. Traub); Patzcuaro, State of Michoacan, on *Catharus o. occidentalis* (P.S. Martin); Temamatla, 2200 m., 35 kilom. S.E. of Mexico City, State of Mexico, 1 ♀ on *Carpodacus m. mexicanus,* July 30 (Mrs. Ana María de Buen de Biagi).

O. fringillina is ubiquitous throughout the Holarctic Realm, a northerly type of distribution unique among the Hippoboscidae (Part I, pp. 241–243). It is the bird-fly extending farthest north during the summer (to 68° N. in America and 70° N. in Europe). Moreover, it is confined to the cool temperate areas, as shown below, and strays only exceptionally to subtropical territory. Its present wide range is evidently ancient and wholly natural.

Elizabeth M. Boyd (1951) suggested that probably the starling, *Sturnus vulgaris,* and the English or house sparrow, *Passer domesticus,* were responsible for the introduction of *O. fringillina* into North America. The available evidence contradicts this view. The fly has a great variety of American hosts, having been taken in North America on 107 species (and 26 more subspecies) of native birds, from which I have now 358 verified records. By contrast, there are only 6 records from 4 introduced birds (*Phasianus, Acridotheres, Passer,* and *Sturnus*). The scarcity of *fringillina* on the European starling, on both sides of the Atlantic, in spite of the prevalence of this bird, marks it as an accidental host. Miss Boyd

[31] Rondani's supposed "*avicularia*" from Mexico may have been an *Ornithoctona;* van der Wulp's (1903) supposed *Ornithomyia avicularia* from Río Sucio, Costa Rica, seen at the British Museum, is *Ornithoctona fusciventris.*

herself found only one fly by examining 287 starlings during 1944–1946, in New York, Massachusetts, Connecticut, Maryland, Ohio, and Indiana. In addition to a published record from Vancouver (Ferris, 1927), I have seen a third fly from New York. There are only two American records (Ontario and Vancouver) from the English sparrow, which in Europe also is seldom infested. Moreover, historical evidence shows that *O. fringillina* occurred in the United States before the introduction of either starling or English sparrow. Say described his *O. pallida* (a synonym of *fringillina*) in 1823 from a fly taken on the native eastern bluebird. According to May T. Cooke (1928, *U. S. Dept. Agric., Circ.* **40**), unsuccessful attempts to introduce the starling were made from 1850 onward, and its permanent establishment in North America dates from about 1869 in Boston and 1890 in New York City. The introduction of the English sparrow occurred from 1850 to 1881 (W.B. Barrows, 1889, *U. S. Dept. Agric. Div. Econ. Ornith. Mammal., Bull.* **1**).

The locality records bring out the predilection of *O. fringillina* for a cool temperate climate. Nearly all localities of my list (170 out of 177) are from north of 36° N. Farther south the species is rare and sporadic, as there are no records from Virginia, North Carolina, South Carolina, Georgia, Florida, Alabama, Mississippi, Louisiana, Arkansas and Oklahoma, and only a few from Tennessee (1) Texas (1), New Mexico (2), Arizona (2), and southern California (1 in San Bernardino Co.). The paucity of captures in the southern states cannot be attributed only to the vagaries of collecting, as the small *Ornithoica vicina* is often reported from the same types of hosts in that area. The few southern captures are probably flies carried by migratory hosts arriving from farther north. This might also explain the sporadic occurrences in the Mexican highlands, which, moreover, are faunistically an extension of the Nearctic Region.

In the Old World likewise *O. fringillina* is a fly of the temperate zone. It is the only bird-fly known from Iceland and the boreal parts of Europe and Asia. It is very rare in southern Europe, where it has not been taken south of 40° N.; while in eastern Asia the southmost record is from Fukien (about 27° N.). I know of no reliable capture in the Paleotropics. *Ornithomyia variegata* Bigot, from New Zealand and temperate Australia, appears to be cospecific with *O. fringillina;* in which case the reappearance of the fly in these temperate areas of the southern hemisphere is most probably due to accidental importation by Man.

The distribution of *O. fringillina* contrasts sharply with that of its Old World close relative, *O. avicularia* (Part I, p. 240), which not only avoids the colder temperate regions (being accidental or absent north of 57° N.), but extends over the subtropical and tropical parts of Africa, Asia, the Malay Archipelago and Australia, reaching even Tasmania and New Zealand. The two species overlap over a large zone in the warmer temperate parts of their ranges, where they may be regarded as forming a sympatric pair, sometimes occurring on the same types of hosts or even on the same individual bird (Part I, p. 223).

Known Nearctic Hosts of *O. fringillina* (verified individual records in parentheses). Falconiformes (12 and 2 undetermined hawks): *Accipiter cooperii* (2); *A. striatus velox* (2); *Circus cyaneus hudsonius* (1); *Cathartes aura teter* (1); *Falco c. columbarius* (1); *F. columbarius bendirei* (1); *F. s. sparverius* (3); *Pandion haliaetus carolinensis* (1). Galliformes (26): *Bonasa u. umbellus* (1); *B. umbellus togata* (2); *B. umbellus umbelloides* (4); *B. umbellus yukonensis* (1); *Canachites c. canadensis* (2); *C. franklinii* (3); *Colinus v. virginianus* (1); *Dendragapus o. obscurus* (1); *D. obscurus fuliginosus* (2); *D. obscurus richardsoni* (7); *Lagopus l. lagopus* (1); **Phasianus colchicus* (1). Charadriiformes (3): *Larus delawarensis* (1); *Philohela minor* (2). Strigiformes (8): *Asio wilsonianus* (1); *Bubo v. virginianus* (1); *Glaucidium gnoma californicum* (4); *Otus asio mccallii* (1); *Surnia ulula caparoch* (1). Coraciiformes (1): *Megaceryle a. alcyon* (1). Piciformes (18): *Colaptes auratus luteus* (1); *C. c. cafer* (2); *C. cafer collaris* (2); *Dendrocopos pubescens gairdnerii* (1); *D. pubescens leucurus* (1); *D. pubescens medianus* (2); *D. v. villosus* (1); *D. villosus harrisi* (2); *Picoides arcticus* (2); *Sphyrapicus v. varius* (1); *S. varius nuchalis* (1); *S. varius ruber* (2). Passeriformes (294): **Acridotheres c. cristatellus* (1); *Agelaius p. phoeniceus* (9); *Ammodramus savannarum australis* (1); *Anthus spinoletta rubescens* (1); *Aphelocoma c. californica* (1); *Baeolophus* sp. (1); *B. bicolor* (1); *B. i. inornatus* (1); *Carpodacus mexicanus frontalis* (1); *C. p. purpureus* (4); *C. purpureus californicus* (1); *Compsothlypis americana pusilla* (1); *Corvus brachyrhynchos hesperis* (1); *Cyanocitta c. cristata* (5); *C. stelleri frontalis* (1); *Dendroica a. aestiva* (1); *D. castanea* (1); *D. c. coronata* (2); *D. p. pinus* (1); *D. tigrina* (1); *Dolichonyx oryzivorus* (4); *Dumetella carolinensis* (7); *Euphagus carolinus* (1); *Geothlypis t. trichas* (2); *G. trichas brachidactyla* (4); *Hedymeles ludovicianus* (2); *H. m. melanocephalus* (1); *Helmitheros vermivorus* (1); *Hesperi-*

phona v. vespertina (6); *H. vespertina brooksi* (2); *Hylocichla f. fuscescens* (6); *H. g. guttata* (1); *H. guttata faxoni* (3); *H. mustelina* (3); *H. u. ustulata* (1); *H. ustulata swainsoni* (2); *Icteria virens longicauda* (1); *Icterus galbula* (3); *Junco h. hyemalis* (9); *Junco mearnsi* (1); *J. o. oreganus* (2); *J. oreganus shufeldti* (1); *Lanius ludovicianus excubitorides* (1); *Loxia curvirostra bendirei* (2); *L. curvirostra pusilla* (1); *Melospiza g. georgiana* (4); *M. l. lincolnii* (5); *M. lincolnii gracilis* (1); *M. m. melodia* (25); *M. melodia gouldi* (2); *M. melodia morphna* (2); *Mniotilta varia* (1); *Molothrus a. ater* (12); *M. ater artemisiae* (1); *Myadestes townsendi* (2); **Passer d. domesticus* (2); *Passerculus sandwichensis savanna* (4); *Passerella iliaca* subsp. (1); *Penthestes* sp. (1); *P. a. atricapillus* (2); *P. h. hudsonicus* (2); *P. rufescens barlowi* (1); *Perisoreus c. canadensis* (1); *Pipilo e. erythrophthalmus* (6); *P. fuscus petulans* (2); *P. maculatus falcifer* (4); *Piranga erythromelas* (1); *P. ludoviciana* (2); *Plectrophenax n. nivalis; Pooecetes g. gramineus* (2); *Quiscalus q. quiscula* (1); *Q. quiscula aeneus* (3); *Richmondena c. cardinalis* (5); *Sayornis s. saya* (1); *Seiurus a. auricapillus* (2); *S. n. noveboracensis; Setophaga ruticilla* (1); *Sialia s. sialis* (2); *Sitta* sp. (1); *S. c. carolinensis* (2); *Spizella a. arborea* (1); *S. p. pusilla* (2); *S. p. passerina* (15); **Sturnus v. vulgaris* (2); *Thryomanes bewickii spilurus* (1); *Thryothorus l. ludovicianus* (1); *Toxostoma r. rufum* (7); *Troglodytes a. aëdon* (2); *Turdus m. migratorius* (18); *T. migratorius propinquus* (3); *Tyrannus tyrannus* (1); *Vermivora celata lutescens* (1); *V. peregrina* (1); *V. pinus* (1); *V. r. ruficapilla* (2); *Wilsonia citrina* (1); *Zonotrichia albicollis* (19); *Z. coronata* (4); *Z. leucophrys gambelii* (3); *Z. leucophrys nuttalli* (2); *Z. leucophrys pugetensis* (1). A recent record adds to the Passeriformes *Oporornis formosus*, with 3 flies, at Hyattsville, Prince Georges Co., Maryland, Aug. 3, 1954 (Dr. Leslie Teller).

In addition there are 4 records of *O. fringillina* from Mexico, 3 of them from identified Passeriformes: *Catharus o. occidentalis, Turdus migratorius* subsp., and *Carpodacus m. mexicanus.*

Bionomics. The following topics are discussed in Part I: effect of macroclimate (pp. 121–122); parasitism of mites (pp. 152–155); phoresy of Mallophaga (pp. 168–171) and Thysanoptera (p. 174); sex ratio (p. 178); mating (p. 183); larviposition (pp. 191–193); straggling (p. 217); interspecific competition (pp. 223–224); frequency and density of infestation (pp. 229–231); seasonal fluctuations (pp. 241–243); acquired breeding hosts (p. 245); and host specificity (pp. 325–327).

O. fringillina, a polyxenous parasite with little host specificity, breeds successfully on a variety of taxonomically unrelated birds. The Nearctic host list now comprises 107 native species (and 26 more subspecies), in 7 orders; but only the Passeriformes (80 species, with 289 or 80 per cent of the 358 verified records), Galliformes (6 species, with 25 or 7 per cent of the records), and Piciformes (6 species, with 18 or 5 per cent of the records) contain unquestioned breeding hosts. Certain Falconiformes (7 species, with 14 or 4 per cent of the records) possibly also serve as such in America, as they do in Europe; although birds of prey sometimes acquire flies temporarily from their prey (Part I, p. 216). The fly occurs only as an accidental stray on Charadriiformes (3 records from 2 species), Strigiformes (8 records from 5 species) and Coraciiformes (1 record). *O. fringillina* seems to be much rarer on Galliformes in America than in northern Europe, possibly owing to the successful competition of the larger *Lynchia americana;* but the paucity of records of *Ornithomyia* on American game birds may be due in part to its being often overlooked because of its small size, the few flies per bird, or the swiftness with which it leaves the dead host.

In North America *O. fringillina* sometimes competes with *Ornithoica vicina* on Passeriformes, as discussed before. In the Palearctic Region competition between the closely related *O. fringillina* and *O. avicularia* is presumably keener, as both inhabit in part the same geographical area and often breed on similar hosts (Part I, p. 327). There are now reliable records of *O. avicularia* for 52 species of Palearctic birds in 10 orders; but only Passeriformes (23 species) and Falconiformes (7 species) seem to be true breeding hosts. Fifteen of the 23 Passeriformes and 4 of the 7 Falconiformes have yielded both *avicularia* and *fringillina;* but mixed infestations on the same individual bird are rare (Part I, pp. 223–224).

It is fairly evident that, among the Passeriformes, certain species are favored and others only casual hosts of *O. fringillina.* Of 289 verified native Nearctic records, two-thirds are from members of the 12 genera *Melospiza* (39), *Zonotrichia* (29), *Turdus* (21), *Spizella* (18), *Hylocichla* (16), *Molothrus* (13), *Junco* (13), *Pipilo* (12), *Agelaius* (9), *Hesperiphona* (8), *Dumetella* (7), and *Toxostoma* (7). Moreover, the 80 species from which the fly is known are less than one-third of the Nearctic passerine fauna, of some 300 truly native species. The absence or scarcity of the fly on many passerines cannot be due entirely to insufficient collecting

or to the methods used in obtaining the records, even though the host list will be extended by future observations.

As *O. fringillina* is restricted to cool temperate areas, its yearly life cycle and seasonal fluctuations are of much interest. In Europe the fly seems to overwinter mainly, if not wholly, as puparia, most adults dying off in early winter, regardless of whether the host remains as a winter resident or migrates to warmer quarters; at any rate, flies are found on birds only from early April to mid-November. In North America conditions seem to vary. In the northeastern United States the fly occurs on birds from early July to early November (in Massachusetts from July 3 to November 6); but in the Pacific Coast states, where winters are noticeably milder at the same latitude, it has been taken on birds from March 15 to December 26 and possibly remains on certain birds the year round; and in the Far North, the few records are all from the summer (mid-June to mid-September in Alaska; late July in Yukon; late September in Labrador).

It is as yet uncertain whether *O. fringillina* has one or two generations a year. Ash (1953, p. 207) bred 4 viable puparia obtained from wild gravid flies, in Sweden (3 flies on September 2 and 9) and England (1 fly on July 20), adults emerging the next spring (March 29 to May 28) respectively after 260, 252, 227 and 207 days (average, 237 days). He concluded that there is only one generation a year. As his puparia were deposited in summer, they could be expected to overwinter and produce the flies which reinfest birds in spring. It remains possible, therefore, that an earlier adult generation might emerge from puparia produced during April and May, which flies could be the chief producers of the later (second) brood of overwintering puparia. Ash (1950, p. 86, as *O. lagopodis*) also reported some 60 flies from a brood in the nest of a merlin, *Falco columbarius aesalon*, in England, July 7, the heaviest infestation on record for *O. fringillina*. The fly is often more abundant on nestlings and fledglings than on adult birds, presumably because the young are unable to get rid of the flies, while the parents do not attempt to remove them. It is difficult to see how heavy nest infestations could be derived only from overwintering puparia, which are never found in large numbers in the nests. More probably they are the offspring produced in spring and early summer when the fly's reproductive activity increases during the brooding season of the hosts, in response to the better opportunities for feeding and pupal incubation. After the fly population is built up in early summer, winter puparia are pro-

duced at a slower rate and the number of flies decreases on the juvenile and adult birds. The available data are inadequate for a study of the seasonal fluctuations of *O. fringillina* in North America, where almost no observations have been made on the larviposition of this fly. Spencer (1938, p. 43) reported finding on a long-eared owl, *Asio wilsonianus,* in British Columbia, in February, a fly dragging its empty puparium; but this does not actually prove that the puparium had been deposited in the feathers of the bird.

The puparium of *O. fringillina* was described or figured in Europe by A.E. Shipley (1909, p. 322; Pl. 44, fig. 25; as *O. lagopodis*) and P. Johnsen (1948, p. 290, figs. 5 and 7); in America by R. Elliott and J. Dearness (1899, p. 60, fig. 34; as *Ornithomyia* sp.) and C.M. Herman (1945, p. 19, fig. 11*B*; as *O. anchineuria*). The following description is based mainly on a mature puparium obtained from a fly in Massachusetts. It is very broadly oval or subcircular seen from above (Fig. 28*E*), 2.8 to 3 mm. long and 2.2 to 2.6 mm. in greatest width (slightly before mid-length), broadly arched at both ends and scarcely narrower behind. In profile it is very lightly depressed, about 1.8 mm. thick, equally convex dorsally and ventrally, with the side edges obtusely rounded. At the posterior end the two peripneustic lobes (Fig. 28*C*) form one elliptical, slightly raised cap, with wavy, hexagonal contour and a wide, shallow, apical pit; two circular surface structures, placed one on each side in this pit, I regard as the scars of the stigmata of an earlier larval stage, corresponding to the "buttons" of the third stage larva of the Muscoidea; each side half of the cap is divided by depressions into three wedge-shaped raised areas or low ridges, somewhat wider than the depressions, radiating from the apical pit; each ridge bears from 12 to 15 small tubercles corresponding to spiracular pores, placed in a single file which is almost straight near the pit and then curves broadly and regularly at the outer end in the shape of a question-mark; on the ridges, the surface is nearly smooth or with a few wrinkles, but in the intervening depressions it bears a network of engraved lines similar to those found elsewhere on the body, but stronger and more crowded. The integument of the body appears shiny and nearly smooth under a hand-lens; but a high magnification discloses an irregular, polygonal network of fine engraved lines like that of the surface of leather. The larval segmentation is barely indicated here and there by a few superficial, incomplete rows of confluent punctures laterally (but not over the side edges); I can find no trace of similar longitudinal side lines of punctures. At the anterior end, the semi-

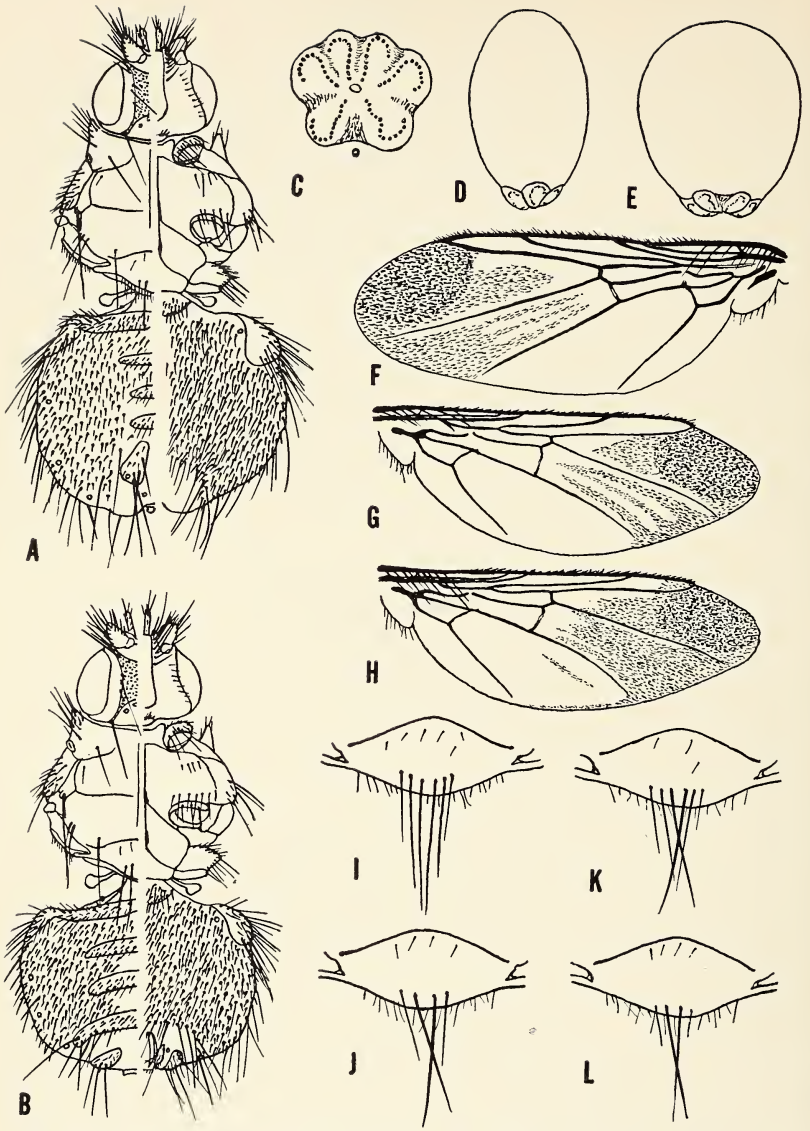

Fig. 28. *Ornithomyia fringillina* Curtis. **A–B**, body in dorsal and ventral view: **A**, ♀, East Westmoreland, on *Melospiza m. melodia;* **B**, ♂, Berkeley, on *Zonotrichia coronata.* **C–E**, puparium: **C**, peripneustic lobes; **D**, puparium in side view; **E**, same from above. **F–H**, wings showing variation in extent of microtrichia; **F**, Curtis' ♀ type (left wing); **G**, ♀, Shorewood near Milwaukee, on *Zonotrichia albicollis;* **H**, ♀, near Peshtigo, Wisc. **I–L**, scutellum showing variable number of preäpical bristles: **I**, ♀ type of *O. lagopodis* Sharp, Caithness, on *Lagopus scoticus;* **J**, ♀, Newfoundland, on *Hylocichla ustulata swainsoni;* **K**, ♀, Wasau, on *Colaptes cafer collaris;* **L**, ♀, Shorewood near Milwaukee, on *Zonotrichia albicollis.*

circular top seam, along which the puparium splits when the imago emerges, is visible as a slight raised line; but only traces of the circular seam are present at both ends of the semicircular seam.

To the 42 cases of phoresy of Mallophaga mentioned for *O. fringillina* in Part I, the following may be added. Of 2 flies taken on *Pipilo fuscus petulans* by O. E. Sousa at Berkeley, California, one female carried one louse.

Affinities. *O. fringillina* and *O. avicularia* are so closely related that until recently they were commonly lumped or confused. The characters used in my key, although few and of relatively minor importance, separate them clearly. These two flies seem to be what has been variously called dual, vicarious, substitute, representative or sympatric species. The lack of doubtful specimens is particularly conclusive in Europe, where both species are equally common in certain localities, often parasitizing the same birds and sometimes occurring together on an individual host. If they interbred in nature, connecting hybrids would be observed now and then, which is not the case. Moreover, as pointed out by P. Johnsen (1948, p. 290), the puparia offer additional specific characters which remove any doubts that might remain. As compared with *O. fringillina,* the puparium of *O. avicularia* is larger, 3.2 to 3.8 mm. long and 2.8 to 3 mm. in greatest width, more oval from above, and relatively narrower behind; the polypneustic lobes have essentially the structure described for *fringillina,* but each of the radiating ridges bears 15 to 25 spiracular pores grouped radially or placed more or less in two irregular lines; the larval segmentation is fairly well indicated by 10 transverse lines of close set, large punctures, most of the lines broadly interrupted in the middle dorsally and ventrally and all of them lacking on the side edges; and two longitudinal, complete or incomplete lines of similar punctures run on each side a short distance from the edge. The specific distinctness of *fringillina* and *avicularia* may be regarded as well established and is corroborated by their different distribution and ecology.

The two characters separating *O. fringillina* and *O. avicularia* in my key vary within narrow extremes and there is scarcely any overlapping. The wing of *O. avicularia* is 6 to 7.5 mm. long (average, 6.5 mm.); that of *O. fringillina,* 4.5 to 5.5 mm. (average, 4.8 mm.). As is often the case in ectoparasites, dwarfs sometimes occur in both. A male *fringillina,* taken on a brown towhee, *Pipilo fuscus falcifer,* at Berkeley, California, was only 3 mm. in total length (preserved in spirit), with the wing 4 mm. long; whereas other males from the same host in that locality, were nearly 4 mm.

long, with a wing of 5.4 mm. In the European *O. avicularia* seen, the number of preäpical bristles on the scutellum varies from 6 to 10, but most flies have 8 in 4 pairs. In a representative sample of 24 flies, from southern Germany, 1 had 6, 3 had 7, 16 had 8, 1 had 9, and 3 had 10 bristles. The majority of *O. fringillina,* both in Europe and in North America, have 4 scutellar bristles in 2 pairs; but the median pair is always stronger and the outer one is weak, often hair-like; one must be careful not to overlook bristles that are broken, but can be traced by the minute, pit-like sockets. Flies with only 3 bristles (one of the outer pair missing) are not very rare; those with 5 or 6 bristles are exceptional; and I have seen one fly, from Babylon, New York, with only 2 bristles.

Additional structural differences, which I used at one time (Bequaert and Leclercq, 1947), are too subtle or too variable for practical purposes. Usually the interocular face of *fringillina* is not or barely longer than wide at postvertex, with the inner eye margins distinctly diverging upward; whereas in *avicularia* it is often somewhat longer than wide at postvertex, with the eye margins only slightly diverging. Measurements of a series of flies show that even the average difference is too slight to be trusted and that both species are sometimes almost identical in this respect. There is, moreover, no appreciable sexual difference in the width of the face. The difference in general shape or contour of the head is even less reliable than that of the face.

The different size of the ocelli is clear enough when the two species are compared, but difficult to appraise when only one is on hand. In *O. avicularia,* the anterior ocellus is about as wide as two-thirds of its distance from the posterior pair and usually placed well below a line drawn through the upper eye margins. In *O. fringillina,* the ocelli are smaller and therefore farther apart, the anterior ocellus being only as wide as one-third to one-half of its distance from the posterior pair and usually placed on or barely below a line drawn through the upper eye margins.

Minor differences in the venation of the wing are favored by many dipterists, because they are so easily seen. In *Ornithomyia* they vary much within the same species. In particular, the course of the longitudinal veins, the position and length of the cross-veins and the relative length of the basal and anal cells should not be given undue importance. Owing to the wide range of variation, obvious differences appear when a few specimens are compared; but they break down when large series are studied, as it is impossible to correlate them consistently with other, more reliable char-

acters. Possibly a comparative statistical study of a few hundred specimens may reveal reliable average differences in the venation of *O. avicularia* and *O. fringillina.* Smart (in Edwards, Oldroyd and Smart, 1939, p. 119) states that in *avicularia* the anterior basal ["medio-cubital"] cross-vein is 4 times the length of the anterior ["radio-median"] cross-vein and the anal vein shorter; whereas in *fringillina* the anterior basal cross-vein is only twice the length of the anterior cross-vein and the anal vein longer. This is no doubt correct in many cases; but some *avicularia* and *fringillina* show no appreciable difference in this respect, the anterior basal cross-vein being sometimes about 3 times the length of the anterior cross-vein. The comparative length of the two terminal sections of the costa has also been used as a specific character. In most *fringillina,* the two sections, set off by the 2nd longitudinal vein, are about equal or the last section is slightly shorter; but in some, the penultimate section is nearly $1\frac{1}{2}$ times the length of the last. In *avicularia,* the penultimate section is from $1\frac{1}{2}$ times to almost twice as long as the last; again this varies, although I have not seen an *avicularia* with both sections nearly equal. In many *fringillina,* the anal cell is relatively shorter and wider than in most *avicularia;* but the difference is sometimes imperceptible. The distance between the anterior and the anterior basal cross-veins on the 4th longitudinal varies also and some specimens of either species are identical in this respect.

In both *avicularia* and *fringillina,* microtrichia cover only a small area of the wing membrane. They are restricted as a rule to the 1st and 2nd posterior cells; exceptionally a few hairs occur in the tip of the submarginal cell or form a narrow streak in the apical portion of the 3rd posterior cell; the 1st and 2nd posterior cells usually have some bare streaks, but these vary greatly (Figs. 28*F–H*). Three flies from Alaska grouse, at Fairbanks, Alaska, are more extensively hairy on the wings than any other seen: there are no bare streaks in the 1st and 2nd posterior cells, which are bare only at the extreme base; one of these flies has an additional narrow streak of hairs in the 3rd posterior cell.

Séguy (1936, pp. 105–106) used for specific distinction the so-called jugular bristles ("soies jugulaires") on the antero-ventral portion of the head. These correspond to the vibrissae of the Muscoidea, being placed on the facial ridges at the upper sides of the cavity containing the rostrum membrane and mouth-parts. Owing to the flattening of the head, the facial ridges and their vibrissae have shifted to a ventral position between the antennal pits and the buccal cavity (Fig. 3*C*). According to Séguy, *O. avi-*

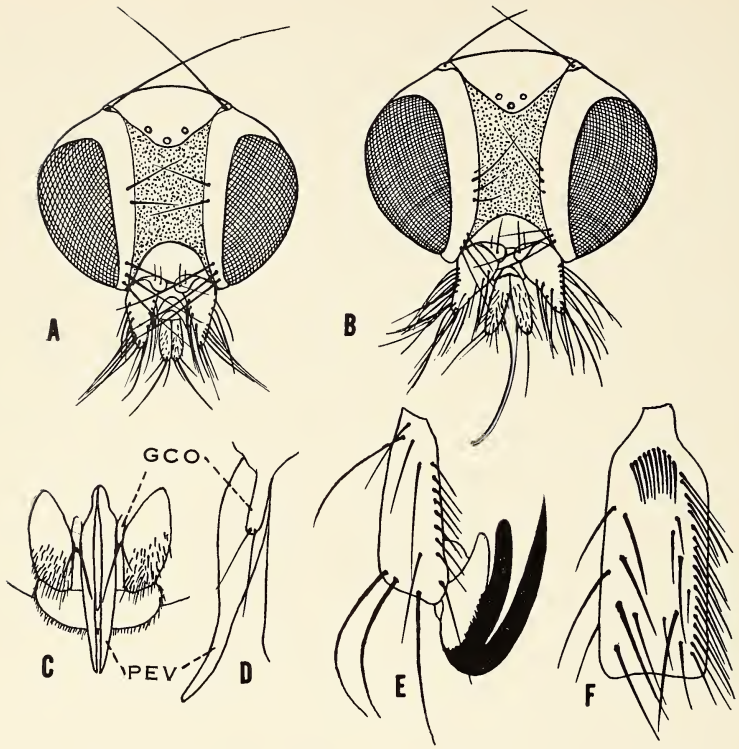

Fig. 29. *Ornithomyia fringillina* Curtis. **A–B**, head: **A**, Curtis' ♀ type; **B**, ♂, Goat Mountain, on *Dendragapus obscurus richardsoni*. **C–D**, ♂ terminalia, Berkeley, on *Zonotrichia coronata:* **C**, from below; **D**, in side view; *GCO*, gonocoxite; *PEV*, penis valve. **E**, distitarsus and claw of hind leg, ♀, Oak Bluffs, on *Spizella p. passerina*. **F**, basitarsus of hind leg from beneath, ♂, Harlan Gulch, on *Dendragapus obscurus richardsoni*.

cularia has 8 to 12 vibrissae, while *O. fringillina* (= *O. chloropus*) has 6 strong vibrissae or exceptionally 8. A study of many specimens has convinced me that the difference is due mainly to the fact that in *avicularia* the vibrissae are stronger, so that some that are only short setae in *fringillina* now appear as long bristles.

The abdomen of *fringillina* bears the same median dorsal sclerites as that of *avicularia,* and the slight differences in size and shape do not help specific identification. In the males, the first two sclerites are longer and wider in *fringillina* than in *avicularia,* so that they are more like the third sclerite. In the female, all three sclerites are wider and longer in *fringillina* than in *avicularia* and

about the same size or the third a little larger. (In Ferris and Cole, 1922, p. 199, fig. 15 of a female *fringillina* shows the first sclerite partly concealed beneath the basal plate, as pointed out by the authors.)

The penis valves or parameres of the male terminalia are so similar that only a direct comparison shows the difference. In *fringillina* they are slender throughout seen from below, and slightly and very gradually widened basad in side view; in *avicularia* they are broader basally and more abruptly widened at the apical third. A somewhat similar difference in the parameres has been claimed between *fringillina* and so-called *lagopodis;* but I suspect that the comparison was usually made with specimens of *O. avicularia* misidentified as *fringillina,* a confusion often made in the past.[32] The small finger-shaped gonocoxites (Figs. 29C–D) are slender, weakly sclerotized and with 2 short bristles as the tip.

I regard color characters, with few exceptions, as unreliable in Hippoboscidae (Part I, pp. 57–60), and this is particularly true for *Ornithomyia.* As there are often fairly definite color differences between certain specimens of different species, it is difficult to be convinced that these differences are not of specific value. But, if many specimens are compared, it soon becomes impossible to find a consistent color difference between *avicularia* and *fringillina,* both species varying from light russet to mahogany-brown, with faint or more pronounced darker areas. The color of the palpi in particular, used by Smart (1939), is often exactly the same in both species. Smart also separates *lagopodis* and *fringillina,* which I regard as cospecific, on the basis of color; to *fringillina* he refers the specimens with the head and thorax uniformly pale; while those with dark markings on the under side of head and thorax he calls *lagopodis.* It is, of course, possible to arrange most of the small *Ornithomyia,* both in Europe and North America, in two groups according to this character; but there remain transitional specimens which must be placed arbitrarily. Moreover, the color differences are not correlated with any other character, certainly not with any difference in size or in extent of the microtrichia in the wing, as Smart implies (*fringillina* with a wing span of 10 mm. and less pubescent wings; *lagopodis* with a wing span of 12 mm.

[32] Although Smart (1939, p. 119) bases his key on characters which I regard as unreliable, in the text he points out correctly that *avicularia* is larger (with a wing span of nearly 15 mm.) than *fringillina* or "*lagopodis*" (with a wing span of 10 to 12 mm.).

and more pubescent wings). Most North American *fringillina* are light reddish-brown, yet often as large and as extensively hairy on the wings as the dark-colored Scottish grouse-flies. Some American specimens also are dark mahogany-brown; one such fly, with the wing 5.5 mm. long and 4 preäpical scutellar bristles, came from *Zonotrichia leucophrys gambelii* in the State of Washington, where the summer is usually cool and damp. It might be advisable to investigate whether the darker color of the *fringillina* found on grouse in Scotland is due to the macroclimate, to an ecological peculiarity of the host, or to some other factor.

According to Smart (1939), freshly-caught *avicularia* and *fringillina* have a greenish tinge in their body coloration never found in *lagopodis*. This dull, grass-green color of certain hippoboscids, probably produced under suitable conditions by all species of *Ornithomyia,* is caused by a green pigment in the haemolymph (Part I, pp. 58–60). It is absent in the newly-emerged fly and develops some time after feeding. It disintegrates rapidly after death if the insect is preserved in spirit and more gradually if it is kept dry, traces remaining longer in the legs and in the main veins of the wings than elsewhere. It should be noted that specimens now found pinned in collections may have been at first preserved in spirit. The green color may also be hidden in the live fly by the darkening of the integument, possibly explaining why it was not noticed in the so-called *lagopodis*.

Original description of *O. fringillina:* "Ochreous, inclining to bright green; hairs black; maxillae, eyes, a spot on the base of each antenna, and another where the ocelli are placed, piceous; head and thorax shining ochreous, faintly variegated with brown, leaving a pale line down the back; abdomen dull green, pilose; wings iridescent, slightly smoky, with a darker large oval spot at the apex; nervures black; legs verdigris-green; tibiae with a black streak outside; claws and upper side of terminal joint of hinder tarsi black." Curtis drew up this description from at least three specimens, two of which appear to be lost. The third, a ♀ now at the Australian National Museum in Melbourne, may therefore be designated as the lectotype. Mr. Gordon B. Thompson (1936) published on it the following notes, based on my own examination of the specimen: "The type is a well-preserved female, without indication of locality or host. It agrees in every respect with the common, smaller species of *Ornithomyia,* described by Bergroth as *O. chloropus* and by Sharp as *O. lagopodis.* The head is distinctly wider than high. The vertex [postvertex] is moderately long, so that the anterior ocellus lies slightly below a line drawn through the upper orbits. Inner orbital bristles few, in two widely separated groups (2 placed about the middle, 3 near the lower edge); gula (ventrally) with setae only on the low, somewhat converging ridges separating the infrabuccal membrane from the postgenae; no postorbital setae. Ocelli small. Frons [interocular face] nearly twice the width of an eye. Fronto-clypeus [frons] with a shallow median pit-like depression near the upper margin. Scutellum fringed with short, sparse hairs along the extreme hind margin and with 2 pairs of preäpical bristles, of which the inner pair is much the longer; disk otherwise

bare. Humeral angles short and broad, barely reaching beyond the upper margins of the eyes. Wing short, 5 mm. long; apical section of costa about two-thirds of the length of the penultimate section; second basal cell (*M*) short and of normal width, closed by an anterior basal cross-vein (*m-cu*) which is about twice the length of its distance from the anterior cross-vein (*r-m*); anal cell (*1st An*) much less than half the length of the second basal cell. Length (from tip of palpi to tip of abdomen), in dry condition, 3.6 mm.'' Head and wing of this type specimen are drawn in Figs. 29*A* and 28*F*. Continental European authors have used the name *O. fringillina* for the long-headed species of barn swallows, *O. biloba* Dufour, clearly an erroneous identification, as the barn swallow fly has never been taken in the British Isles.

Original description of *O. pallida:* ''Pale; intermediate cellule of the wing extending nearly to the tip of the outer cellule. Eyes blackish-chestnut; antennae chestnut, tip white; labrum bifurcated, white; hypostoma whitish; front yellow-white, a brown lunule above the hypostoma and spot on the vertex; throat and cheeks white; thorax varied with pale-yellowish and pale honey-yellow, impressed cruciform lines distinct; scutel pale honey-yellow, edged with pale-yellow; costal nervures dark-brown, at base, and those of the disk brown, the transverse nervure of the intermediate cellule is in contact with that of the preceding cellule; pectus and feet white, tibia with a brown line, tarsi tinged with green; nails black; abdomen yellowish-white. Length less than $\frac{1}{5}$ inch [5 mm.].'' Say's type is lost, but there can be little doubt that he described the common North American *Ornithomyia.*

O. anchineuria Speiser, being merely a change of name, has no type properly speaking. It is doubtful that Speiser saw a specimen at the time he proposed the new name, the character of the ''basal cells nearly equally long,'' which he mentions, being seemingly taken from Say's description.

Original description of *O. chloropus* (German text translated): ''Fusca, angulis anticis prothoracis et pectore pallide testaceis, capite subtus, maculis duabus basalibus elongato-triangularibus exceptis, dilute virescente, pedibus aeruginosis, alis leviter umbratis, venis nigris, vena longitudinali quarta ante medium cellulae basalis posterioris, anguste et vena transversa posteriore medio late albo-interruptis, vena longitudinali prima duplicata longius ante venam transversam anteriorem in costam exeunte, apice venae longitudinalis secundae ab apice primae ac tertiae aeque longe distante, cellula basali posteriore anteriore paullo breviore et cellula anali duplo et dimidio longiore. Long. corp. 4–4.5 mm., alae 5 mm. Brown, fairly shiny, with black setae. Head circular, brown above, paler and more shiny at base and on orbits, ocellar spot [post-vertex] distinct, but ocelli flat and inconspicuous; a seta at the base of the antennae, in the middle of the orbits and some distance behind the posterior angle of the eye; the semi-lunate plate above the antennae [lunula] slightly depressed, somewhat angular posteriorly; antennae moderately wide, with long setae, curved and claw-shaped, convex above, concave below, yellow, blackish at base and tip; proboscis black, the single middle piece not extending beyond the lateral valves [palpi], which are setulose at tip; head pale green below, on each side with an elongate, triangular, basal brown spot, which extends beyond mid-length where it ends in a point; anteriorly one or two longer setae on each side before the oral margin; medially, between base of antennae and proboscis, several shorter setae at oral margin, so close as to simulate a palp-like organ. Thorax above with a fine impressed longitudinal line, laterally with some long setae, brown, the anterior angles rather extensively yellowish but with a brown spot, the sides also paler, the dorsum arched before the scutellum. Scutellum about twice as broad as long, brown, finely cross-wrinkled, setose at apex. Sternum pale yellowish, laterally with some weak setae before mid coxae. Wings slightly infuscate, extending for over half the length beyond tip of abdomen; veins of anterior half thick and black as usual, those of posterior half pale and much thinner; costa sparsely setose near base; 1st

longitudinal vein ending in costa rather far basad of anterior cross-vein; tip of 2nd longitudinal midway between that of 1st and 3rd longitudinals; 4th longitudinal with a narrow white ring [bulla] before mid-length of posterior [2nd] basal cell, where it is angularly interrupted and runs close to base of 3rd longitudinal; posterior [anterior basal] cross-vein at least 3 times as long as anterior cross-vein, broadly white [with a bulla] in the middle; posterior [2nd] basal cell a little shorter than anterior [1st] basal cell and 2½ times as long as anal cell. Legs verdigris, tinged with yellowish in spots; femora and tibiae compressed; fore femora much broadened above, with some very long setae on front side of apical half; legs otherwise rather sparsely and uniformly setose; terminal segment of fore tarsi nearly as long as other segments combined; terminal segment of hind tarsi relatively shorter; claws black, but basal accessory tooth ["heel"] pale reddish-yellow, at least apically; main teeth with a small seta on basal upper half. Abdomen a little shorter than thorax, somewhat wider than long, brown, with rounded sides, puffy, greenish-yellow, setulose, the setae longer toward apex, which is deeply notched for the genitalia." Although the sex is not mentioned, the final statement in the description makes it fairly certain that the two cotypes were females. The new species is said to differ from *O. avicularia* in that "the distance between the tips of the 1st and 2nd longitudinal veins equals that between the tips of the 2nd and 3rd; whereas in *avicularia* the former distance is at least twice the latter;" from *O. fringillina* Curt. (*tenella* Schin.) in the "considerably shorter 1st longitudinal vein;" and from *O. metallica* Schin. in the much longer posterior [2nd] basal cell. The description originally given of the venation of *O. ptenoletis* is said to be so confused that a comparison is difficult, although that species, it is claimed, cannot be the same as *O. chloropus*. The comparisons with other species are very vague. The location of the 2 cotypes was not given and they are not now at the Zoological University Museum in Helsingfors. They may have been returned to the collector, V. Pousar. Of 18 *Ornithomyia* taken in Finland and received from Dr. R. Frey, 17 were what I call *fringillina* and only one the large *O. avicularia*. None of these *fringillina* were from Bergroth's type host; but three were from other species of owls, *Asio otus, Surnia ulula,* and *Bubo bubo,* showing that, in Northern Europe at any rate, *O. fringillina* is a frequent parasite of nocturnal birds of prey. Some of these specimens had been labelled before *O. chloropus*. European flies received as *O. chloropus,* from other sources, were invariably *fringillina*. Bergroth's description fits that species well. His comparison with a supposed "*fringillina*" was actually with *O. biloba* Dufour (=*O. tenella* Schiner).

Original description of *O. lagopodis:* "Supra nigricans, subtus pallide testacea, pedibus fusco-testaceis; pectore utrinque fusco-nigro-biplagiato. Long. corp. 5 mm.; expans. alarum, 11½ mm., long. alae sing., 5 mm. Smaller than *O. avicularia,* distinguished by its peculiar lurid blackish color, without any trace of green even on the feet or legs; the rostrum is black and the hairs of the body and appendages are shorter than in the better known form; on each side of the thoracic pleuron, between the front and middle legs, there is a very large dark patch extending as far towards the middle as the base of the front coxa, and divided into two parts by an oblique pallid line. The head is considerably smaller and narrower than that of *O. avicularia,* and has beneath a very large area of smoky color on each side. Mr. Collin has pointed out to me that the segments, or abscissae, of the costa afford a good character; the relative lengths of the outer two being in *O. lagopodis* as 9 to 8, and in *O. avicularia* about 12 or 12½ to 8. The bristles on the scutellum are usually more numerous, as well as larger, in *O. avicularia.*" Sharp described the species from 26 specimens collected in Scotland, either on grouse or without a host. Several of these are now at the British Museum and two, from Caithness, mounted side by side on a pinned square of cork, are labelled "types." According to Dr. G. B. Fairchild (*in litt.,* 1953), in one of these types both wings are 5 mm. long, while in

the other the left wing is 4.9 mm. and the right, 5.2 mm. Two paratypes, from Caithness, are now at the Museum of Comp. Zool., through the kindness of Dr. H. Oldroyd. In the specimens from Caithness there are usually 3 pairs of preäpical scutellar bristles, but the outer pair are very short and weak. I have given my reasons before for regarding *lagopodis* as not separable from *fringillina*.

Ornithomyia parva Macquart

Figs. 30*A–E*

Ornithomyia parva Macquart, 1843, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1842), p. 436 (no sex; no host. "From Brazil or Chile." Presumed 4 cotypes from Bigot Coll., now in the J. E. Collin Coll.) [1843, Dipt. Exot., **2**, pt. 3, p. 279]. Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1143.

Ornithomyia remota Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1144 (no sex; no host. "Isle of Trisram [=Tristan] da Cunha." Type ♀ at Brit. Mus.). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, pt. 1, (for 1950), p. 7. Crichton, 1951, Ent. Mo. Mag., **87**, p. 21 (Tristan da Cunha Group: Nightingale I., on *Nesospiza wilkinsi;* Inaccessible I., on *Nesospiza acunhae.* Gough I., on *Nesospiza jessiae* or *N. goughensis* and *Porphyriornis comeri.* Notes on Walker's type). J. Bequaert, 1954, Res. Norwegian Sci. Exped. Tristan da Cunha 1937–1938, No. 26, p. 45.

Ornithomyia avicularia Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 261 (in part: type of *O. remota* Walker only); 1906, Illustr. British Blood-Suck. Flies, p. 64 (in part: Tristan da Cunha). Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 32 (listed doubtfully from Chile). Not of Linnaeus, 1758.

? *Ornithomyia synallaxidis* Lynch-Arribálzaga, 1881, Expedición Río Negro, Informe Oficial, **1**, Zool., p. 90 (no sex. Argentina: Río Negro, on "*Synallaxis patagonica*" [*Asthenes patagonica*]. Type presumably lost); 1881, Stettin. Ent. Zeitg., **42**, p. 192 (German translation of original description). Berg, 1881, *Op. cit.*, **42**, p. 46.

? *Ornithoctona* (?) *synallaxidis* Speiser, 1902, Termész. Füzetek, **25**, p. 329. Brèthes, 1907, An. Mus. Nac. Buenos Aires, **16**, p. 302. Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Ornithomyia chilensis E.C. Reed, 1904, Rev. Chilena Hist. Nat., **8**, p. 152 (no sex. Chile: Concepción, on "*Diuca grisea*" [*Diuca d. diuca*]. Described from 3 specimens; holotype ♂ and paratype ♀, from Reed Coll., now at California Ac. Sci., San Francisco; present location of 3rd type not definitely known). Not *Ornithomyia chilensis* Macquart, 1843.

Ornothomyia chilensis E.P. Reed, 1932, Rev. Chilena Hist. Nat., **35**, (for 1931), p. 103 (Chile: Valparaiso, on *Diuca d. diuca, Agriornis l. livida, Turdus magellanicus, Mimus thenca,* and *Glaucidium nanum;* some of the specimens carrying Mallophaga of the genus "*Degeeriella*" [=*Brüelia*] and others with mites, supposedly *Myialges caulotoon*).

Ornithomyia paricella Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 349 (no sex; new name for *O. chilensis* E.C. Reed, 1904; with new description of 3 specimens in Speiser Coll., from Concepción, Chile, on *Diuca d. diuca* and *Muscisaxicola macloviana mentalis*); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. J. Bequaert, 1933, Rev. Chilena Hist. Nat., **37**, p. 162. Stuardo, 1946, Catálogo Dípteros Chile, p. 187.

Ornithomyia anchineuria Donoso Barros, 1949, Rev. Médica Chile, **77**, p. 404 (Chile: Arica, on *Agriornis l. livida* and biting Man). Not of Speiser, 1905.

Distribution and Specimens Examined. Tristan da Cunha Group (recorded by Walker, 1849, as *O. remota;* Crichton, 1951, as

O. remota): Inaccessible I., 2♂ on *Atlantisia rogersi* (received from Dr. F. Zumpt), 2♀, 3♂ on *Nesospiza acunhae* (G.J. Broekhuysen), 3♀ on *Nesocichla eremita gordoni,* one carrying 2 Mallophaga (Norway Sci. Exp.—Y. Hagen), and 4♀, 6♂ probably on *Nesospiza acunhae* (Norway Sci. Exp.—Y. Hagen); Nightingale I., 1♀ on *Nesospiza wilkinsi* (G.J. Broekhuysen), 1♀, 1♂ on *Nesospiza wilkinsi* (Norway Sci. Exp.—Y. Hagen), and 2♀, 2♂ on *Nesocichla eremita gordoni* (Norway Sci. Exp.—Y. Hagen).

Gough Island (recorded by Crichton, 1951): 1♂ on *Nesospiza jessiae* or *N. goughensis* (G.J. Broekhuysen); 2 specimens on *Porphyriornis comeri* (G.H. Wilkins).

Argentina (probably recorded by Lynch Arribálzaga, 1881, as *O. synallaxidis*): Valle del Lago Blanco, Chubut (J. Koslowsky); Cafayate, Calchaquí Valleys, 1650 m., Salta, Aug. 17, on *Embernagra platensis olivascens* (K.J. Hayward); Agua Tapada, Distr. Hualfín, Catamarca, on *Caracara p. plancus,* July 19 (S. Pierotti).

Chile (recorded by E.C. Reed, 1904, as *O. chilensis;* Speiser, 1905, as *O. paricella;* E.P. Reed, 1932, as *O. chilensis;* Donoso Barros, 1949, as *O. anchineuria*): several without precise locality, mostly without hosts, but 1♀ on *Agriornis l. livida;* including holotype ♂ and paratype ♀ of *O. chilensis* Reed; 3 of these specimens carrying Mallophaga; Valparaiso, 1♀, 1♂ on *Diuca d. diuca,* one with a Mallophagan, *Brüelia* sp., attached (E.P. Reed); Tofo, 1♀ (T. Hallinan); Maquehue, Temuco, 38° 47′ S., on *Sturnella militaris* (R.M. Middleton), *Agelaius t. thilius,* May 23, *Diuca d. diuca,* June 24, and 3 specimens on *Colaptes p. pitius,* one carrying a Mallophagan; Angol, on *Turdus magellanicus,* Aug. 15, *Cinclodes nigro-fumosus,* April 26, June 27 and July 11, *Diuca d. diuca,* Apr. 2, and *Zonotrichia pileata,* Aug. 10 (D.S. Bullock); Concepción (C. Castillo; P. Herbst); Concon, near Valparaiso (A. Wetmore); Galvarino, on *Zonotrichia pileata* (E.P. Reed); Llico, 37° 14′ S., on *Diuca d. diuca* (E.P. Reed); Baños de Cauquenes (P. Herbst).—In the Bigot Collection, now with Mr. J.E. Collin, 4 flies from Chile, labelled "*O. parva,*" are in my opinion the types of Macquart's species of that name.

O. parva is the only louse-fly of the few endemic land birds of the Tristan da Cunha and Gough Islands. The compact Tristan da Cunha Archipelago, of 3 small islands and 2 islets, lies in the South Atlantic (about 37° S. and 12° 30′ W.), some 1800 miles W. of South Africa and some 3000 miles E. of Argentina. Gough or Diego Alvarez, 220 miles S. of the Tristan Group, is very small. Walker described *O. remota* from Tristan da Cunha in 1849. No

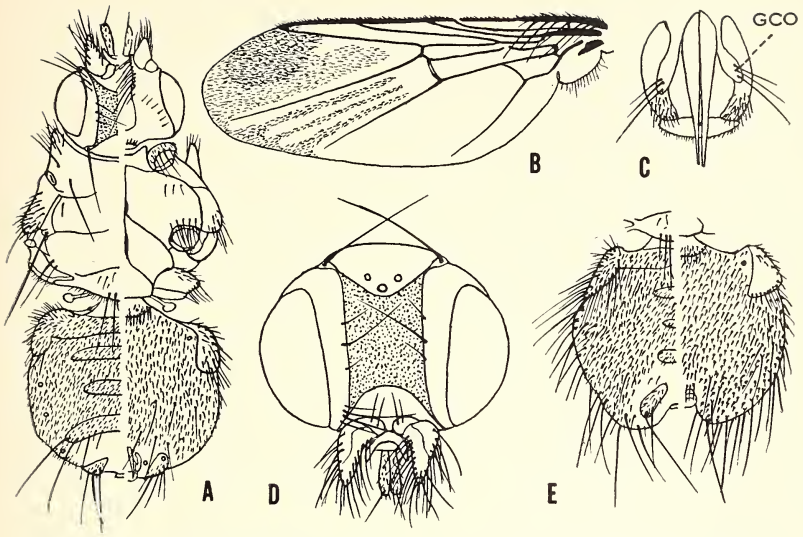

Fig. 30. *Ornithomyia parva* Macquart. **A**, body in dorsal and ventral view, ♂, Valparaiso. **B**, wing ♀, Valparaiso. **C**, ♂ terminalia from below, Nightingale I., on *Nesocichla eremita gordoni; GCO*, gonocoxite. **D**, head, ♀, Valparaiso. **E**, abdomen and scutellum in dorsal and ventral view, ♀, Nightingale I., on *Nesocichla eremita gordoni*.

bird-flies were taken there for nearly a century, until 3 recent parties of ornithologists collected several on 2 of the Tristan Islands, but not on the main island, whose land birds are almost extinct; and some also on Gough. I have seen 30 specimens from these islands, taken on 6 hosts, including all 4 land birds now living on the Tristan Group and 2 of the 3 known from Gough. The species of fly is common on various birds in Chile and Argentina and was, I believe, first described by Macquart as *O. parva*, the later *O. remota* Walker and *O. chilensis* E.C. Reed (renamed *O. paricella* by Speiser) being synonyms. As this fly is unkown from the Old World, it must have reached Tristan da Cunha and Gough from South America either with some of the ancestors of their endemic birds or later on birds that strayed accidentally to the islands. The present distribution of *O. parva* possibly supports the current view that the terrestrial birds of the South Atlantic islands are modified South American types and not related to those of Africa.

The known continental records of *O. parva* show that it is peculiar to temperate, extratropical South America. Northward it reaches about 26° S. in the highlands of western Argentina, but not

as far in southeastern Brazil. At any rate, it was not represented in a fairly large series of hippoboscids collected by Fritz Plaumann in the State of Sa. Catharina (27° S.) (J. Bequaert, 1943*c*). The distribution of *O. parva* is the counterpart of that of *O. fringillina* in temperate North America, both species avoiding areas with a tropical climate.

Known Hosts of *O. parva* (verified individual records in parentheses): Falconiformes (1): *Caracara p. plancus* (1). Gruiformes (2): *Atlantisia rogersi* (1); *Porphyriornis comeri* (1). Strigiformes: *Glaucidium nanum.* Piciformes (1): *Colaptes p. pitius* (1). Passeriformes (21): *Agelaius t. thilius* (1); *Agriornis l. livida* (1); (*?Asthenes patagonica,* if *O. synallaxidis* is a synonym of *O. parva*); *Cinclodes nigro-fumosus* (3); *Diuca d. diuca* (4); *Embernagra platensis olivascens* (1); *Mimus thenca; Muscisaxicola macloviana mentalis; Nesocichla eremita gordoni* (2); *Nesospiza acunhae* (2); *N. jessiae* (or *goughensis*) (1); *N. wilkinsi* (2); *Sturnella militaris* (1); *Turdus magellanicus* (1); *Zonotrichia pileata* (2).

This host list will no doubt be greatly extended by future collecting, as *O. parva* is probably the most common bird-fly in temperate South America. The species agrees with the Holarctic *O. fringillina* in favoring certain Passeriformes for breeding purposes, while showing otherwise no very strict host preference. The few records on two flightless rails in Tristan da Cunha (*Atlantisia*) and Gough (*Porphyriornis*), though of interest, are inadequate to decide whether these birds are efficient breeding hosts; perhaps the fly only strays to them occasionally from the *Nesospiza* and *Nesocichla,* with which they are closely associated in the same environment.

O. parva shares with the two common *Ornithomyia* of the Northern Hemisphere the frequency with which it transports Mallophaga. As noted in Part I (pp. 171–172), of some 50 flies seen, 6, from 3 species of birds, carried such lice (1 from the Tristan da Cunha Group and 5 from Chile). In addition to the flies mentioned in Part I (p. 155), I have seen several others, from Chile, infested with mites.

A puparium of *O. parva,* found by Y. Hagen in the plumage of a juvenile female *Nesocichla eremita gordoni,* on Inaccessible I., Jan. 20, 1938, is probably premature, as it is light-brown. It is shaped like that of *O. fringillina,* 2.6 mm. long, 2.2 mm. wide and 1.5 mm. thick. As in that species, the spiracular pores of the

peripneustic lobes are arranged in a curve shaped like a question-mark on each ridge.

Affinities. In the genus *Ornithomyia, O. parva* belongs to the *avicularia* group and is most closely related to *O. fringillina.* From the latter it differs in the decidedly wider interocular face, which is much alike in both sexes; the inner orbits are also relatively wider. The ocelli are rather large, the anterior ocellus nearly as wide as its distance from the posterior ocelli. Dull green pigment in the haemolymph was observed in several specimens. The extent of mitrotrichia in the wing (Fig. 30*B*) is as in *fringillina;* a very narrow streak of hairs is sometimes present in the 3rd posterior cell. In the male terminalia (Fig. 30*C*), the gonocoxites are wider than in *fringillina,* more lobe-like, and bear a short row of 3 bristles, which are longer than in *fringillina.* I can see no tangible difference in the shape of the penis valves.

Original description of *O. parva* (French text translated): "Picea. Capite testaceo. Pedibus flavidis. Long 2 l. [2 French lines = 4.5 mm.] Pitch-black. Head dark testaceous. Sides of head and occipital spot shiny black. Legs greenish-yellow; femora brownish above, hirsute on upper side only. Legs somewhat yellowish; 2nd [anterior basal] cross-vein very close to the 1st [anterior]." The specimens, collected by Gaudichaud in "either Brazil or Chile," were said to be at the Paris Museum. So far as could be traced, there is no specimen now at the Paris Museum labelled *Ornithomyia parva;* but there is a fly collected by Gaudichaud in 1833 at Valparaiso, Chile, belonging to the species described by Walker (1849) as *Ornithomyia remota.*[33] It is not impossible that this insect was seen by Macquart, even though he was uncertain about the locality. It might even be one of the types of his *O. parva,* although the matter must remain in doubt. In the Bigot Collection, now part of the J. E. Collin Collection, 5 specimens now stand under the label "*Ornithomyia parva.*" One of these, from "New Grenada," was examined by Speiser (1902), who recognized it correctly as a species of *Ornithoctona.* It is actually *Ornithoctona fusciventris* (Wiedemann) and is discussed more fully under that species. I do not regard it as a possible type of Macquart's *parva,* because it is too large and does not otherwise agree with the description, notably in having the "second cross-vein" rather far from the "first," as usual in *Ornithoctona,* certainly not very close to it, the condition more common in *Ornithomyia.* The remaining 4 flies, labelled "Chile," are smaller and agree well with Macquart's description. They are *Ornithomyia* in the modern sense of the genus and cospecific with Walker's *O. remota* and E. C. Reed's *O. chilensis* (= *O. paricella* Speiser). The antennal appendages are slender, not leaf-like; the anterior ocellus is placed slightly below the level of the upper eye margins and the wings are about 6 mm. long. As no other species of *Ornithomyia* is known at present from Chile, I have reached the conclusion that these 4 specimens are at least part of the original type lot of *O. parva,* which were not returned to the Paris Museum and later found their way to Bigot's collection; if so, *O. parva* is the earliest valid name for the *Ornithomyia* of temperate South America.

[33] The specimen now bears an old label with the name "*Ornithomyia platycera*"; but it is not the African species of that name, which is an *Ornithoctona.*

Original description of *O. remota:* "Fulva, scutello sulcis transversis vittato, pedibus fulvis, alis subfuscis. Body pale tawny: head and chest smooth, shining: eyes pitchy; facets rather large: mouth pitchy: scutcheon traversed by a row of slight furrows, widening from the fore border to the hind border, which is beset with a few stout black bristles: abdomen mostly dull, clothed with short black hairs, its tip beset with long black bristles; legs tawny, thickly clothed with black hairs and bristles; claws black: wings pale brown; wing-ribs and veins pitchy. Length of the body 2 lines [4.2 mm.]; of the wings 6 lines [span of wings, 12.6 mm.]." Austen at first (1903) synonymized the type of *remota* with *O. avicularia;* but in his personal reprint (now at British Mus.) a manuscript note, dated January 17, 1923, and quoted by Crichton (1951), reads as follows: "I now consider *O. remota* Walk., owing to the greater width of its frontal margins posteriorly, to be specifically distinct from *O. avicularia* L." I reached the same conclusion after studying the female type at the Brit. Mus. in 1951; but it was found eventually that *remota* is not separable from the earlier *O. parva* Macquart. The wing of Walker's type, measured by Dr. G. B. Fairchild, is 5.8 mm. long.

Original description of *O. synallaxidis* (Spanish text translated): "Picea, nitida; capite supra rubro-testaceo, utrimque carina depressa, nigro-setosa, posticeque spatio ocellari piceis; mesonoto lineola longitudinali flava; alis modice et uniformiter infumatis; femoribus infra sternoque virescentibus. Long. 4.5 mm. Caput supra rubro-testaceum, utrimque carina depressa, nigro-setosa, posticeque spatio ocelligero piceis, nitidis, infra sordide virescenti-testaceum; os nigro-setosum, labro, bulbo rostrifero lobisque lateralibus albidis, his basi margineque externo palpisque piceis, nitidis, rostro flavescenti. Mesonotum angulis anticis productis, sulculo medio instructum sutura satis profunda, medio interrupta, utrimque et postice nigro-setosum, piceum, nitidum, humeris lateribusque sordide virescenti-testaceis, lineola media flava, in aversum paululatim ampliata, guttulisque duabus subobsoletis, coloris humerorum, prope marginem anticum sitis, ornatum; scutellum piceum, nitidum, transversim striatum, sulculo medio, postice in depressionem latam dilatato, munitum, margine nigro-setosum; pleurae piceae, nitidae; sternum sordide virescenti-testaceum, nitidum; pedes picei, nigro-setosi, femoribus infra coxisque ut sterno, sed illis virescentioribus tarsis anterioribus quoque parum virescenti-testaceis, unguibus nigro-piceis; alae uniformiter infumatae, sed hyalinae, venis piceis, costali nigro-setulosa, basi virescenti; halteres fuscescentes, clava alba. Abdomen fusco-virescens, nigro-setulosum et setosum. Very similar to *O. erythrocephala* Leach and *O. parva* Macq. I have nevertheless decided to regard it as different, because the descriptions of these species do not mention the very distinct line on the mesonotum. In addition Leach calls the color of the abdomen of the first-mentioned species yellow ('luteum'), and Macquart calls the wings of the second-mentioned species 'somewhat yellowish' without mentioning the smoky color visible in those of our *Ornithomyia.*" Attempts to trace the present location of the type have failed and it is most probably lost. Although the description mentions little beyond color characters, of doubtful value in the Hippoboscidae, it agrees best, particularly in size, with *Ornithomyia parva,* the common bird-fly of temperate South America. I list it provisionally as a synonym of this species until flies taken on *Asthenes patagonica* in Argentina will settle the matter.

Original description of *O. chilensis* (translated from the Spanish): "Black above, greenish below. Green prevails in life and black after death, because the green occurs in the soft integument between the coriaceous plates and is more visible before the insect shrivels and dries. Green is more extensive below, as well as on the legs. The extent of this tinge differs greatly among the specimens. The description is made from three specimens dead for a week and dry. Head as wide as anterior margin of thorax, depressed between eyes [inner orbits] and posterior elevation carrying the ocelli [postvertex] black and shiny; median depression [mediovertex] dark fulvous; thorax above, main veins of wings, in

anterior and basal areas, black and shiny; 4th, 5th and 6th longitudinal veins less marked and fuscous beyond cross-veins; membrane of wings little transparent, but not infuscate. Thorax with a narrow, longitudinal, fulvous median line. Abdomen blackish above, paler at apex than at base. Legs fuscous above, more or less greenish; green prevailing on under side, very pronounced basally. Clearly close to the European *O. avicularia;* but the great geographical distance separating the two and certain color differences induce me to regard them as distinct. Length 5 to 7 mm.'' The description mentions no character of specific value in *Ornithomyia.* Fortunately, I saw 2 of the 3 original cotypes (♂ and ♀) in 1953 at the California Academy of Sciences. They are unquestionably the species here called *Ornithomyia parva* (= *O. remota*).

Although Speiser proposed *O. paricella* as a substitute name for Reed's *O. chilensis,* he redescribed the species from several specimens, one being from the type host of *chilensis* and most probably the third of Reed's original cotypes, since it was from the type locality. His description reads (translated from the German): ''It is one of the smaller species of the genus and is related to *O. anchineuria m.* (= *pallida* Say) [*O. fringillina* Curtis of Europe and North America], owing to both basal cells being exactly the same length; it differs from that species definitely in being darker. The specimens are 4 to 5 mm. long (Reed gives 5 to 7 mm.); the distance from oral margin to hind margin of scutellum is 2.75 to 3 mm. Head rounded; ocellar triangle [postvertex] and eye margins [inner orbits] blackish-brown; clypeus [frons] leather-brown, with a rounded pit. Antennal appendages yellowish, with a black dot at base, bearing black bristles. Maxillary palpi straight, extending little beyond antennal appendages, blackish-brown. Thorax shiny blackish-brown, with a paler longitudinal suture [median notal suture], yellowish-brown pleura and pale yellowish-brown humeral callosities, which bear a dorsal median blackish-brown dot. Legs pitch-brown, darker above. Wings dusky hazel-brown, transparent. Apical section of costa two-thirds the length of penultimate section; 2nd basal cell the exact length of 1st, the cross-veins being placed above each other; anal cell less than half as long as 2nd cell. Abdomen entirely black, with black setae, also on the 4 tougher chitinous plates.'' I have not seen Speiser's specimens; but, as one of them was possibly a cotype of Reed's *chilensis,* it seems safe to refer them to *O. parva* Macquart, Speiser's description agreeing with what I here call *parva.*

Subgenus *Pseudornithomyia* Lutz, Neiva and da Costa Lima

Pseudornithomyia Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 176 and 185 (monotypic for *Pseudornithomyia ambigua* Lutz, Neiva and da Costa Lima, 1915).

Ocelli lacking, their position sometimes indicated by one or more small, superficial pits. Prosternal lobes unusually long and narrow, rather pointed triangular.

The original diagnosis of *Pseudornithomyia* (as a genus) was as follows (translated from the Portuguese): ''Clypeus [frons] short, emarginate in the middle, almost covered by the hairy antennal appendages, which are tongue-shaped, close together basally and diverging apically. Frons [interocular face] broad; vertex [postvertex] without ocelli. Humeral callosities very large; scutellum elliptical with three rows of setae or hairs; scutellar [pleurotergal] processes subconical. Wings with the veins as in *Orni-*

thoctona, but with microtrichia, except for the bare basal area.'' Except for the lack of ocelli, these characters are not diagnostic, being found also in some species of *Ornithomyia* not closely related to *O. ambigua.*

The subgenus is known at present from the New World only and comprises 2 species. They are the most specialized members of the genus.

Ornithomyia (*Pseudornithomyia*) *ambigua* (Lutz, Neiva and da Costa Lima)

Figs. 31*A–E*

Pseudornithomyia ambigua Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, 7, p. 185; Pl. 27, fig. 5; Pl. 28, fig. 7 (no sex. Brazil: Minas Gerais, 2 specimens on *Leptotilla rufaxilla reichenbachii;* Santa Catharina, 2 specimens on swallows; holotype and paratypes probably in Inst. Osw. Cruz, Rio de Janeiro). Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, 5, (for 1929), p. 27 (Brazil). J. Bequaert, 1942, Bol. Entom. Venezolana, 1, No. 4, p. 81; 1943, Jl. of Parasitology, 29, p. 135. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6.

Distribution and Specimens Examined. Colombia: Buenos Aires, Depto. Santander Norte, 1♂ on *Notiochelidon c. cyanoleuca* (M.A. Carriker, Jr.); Valdivia, Depto. Antioquia, 1♀ on *Notiochelidon c. cyanoleuca* (M.A. Carriker, Jr.).

Venezuela (recorded by Anduze, Pifano and Vogelsang, 1947): Macuto, Caracas, on *Notiochelidon c. cyanoleuca* (N. Dearborn); El Valle, Distrito Federal, near Caracas, on *Iridoprocne albiventer* (C.H. Ballou); La Florida, Distrito Federal, on *Iridoprocne albiventer* (C.H. Ballou); Rancho Grande, between Maracay and Ocumare-de-la-Costa, 3500 ft., State of Aragua, 1♀, 1♂ on *Notiochelidon c. cyanoleuca* (W. Beebe).

Brazil (recorded by Lutz, Neiva and da Costa Lima, 1915; Falcoz, 1930): São Paulo, on a swallow (J. Lane); Botucatú, State of São Paulo, on *Progne chalybea domestica;* Boraceia, State of São Paulo, on *Xenops r. rutilans;* Repressa, State of São Paulo, on *Stelgidopteryx r. ruficollis;* Sta Tereza, State of Espirito Santo, on *Notiochelidon c. cyanoleuca.*

Peru: Pan de Azucar, Río Tarma, on *Notiochelidon c. cyanoleuca* (W. Weyrauch).

As *O. ambigua* has been taken in several widely separated localities, it probably occurs in all tropical parts of South America, but apparently not north or west of the Isthmus of Panama.

Known Hosts of *O. ambigua* (verified individual records in

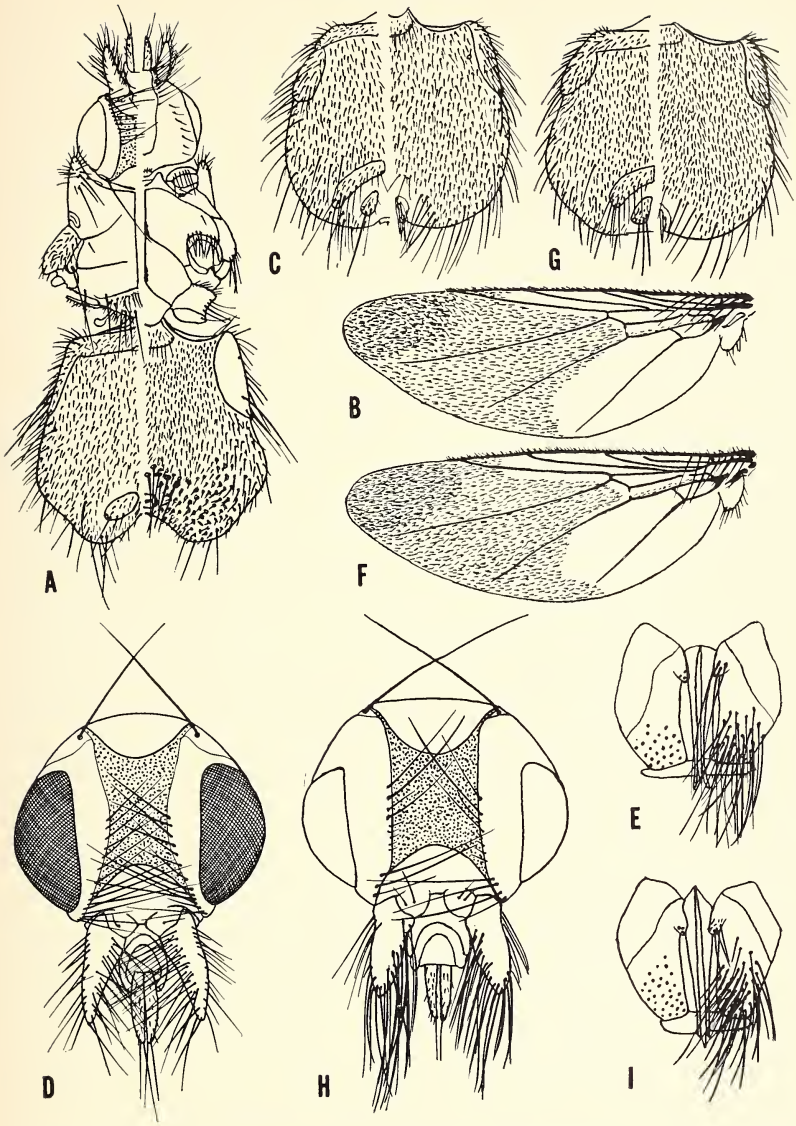

Fig. 31. **A–E**, *Ornithomyia* (*Pseudornithomyia*) *ambigua* (Lutz, Neiva and da Costa Lima), Rancho Grande, on *Notiochelidon c. cyanoleuca:* **A**, body in dorsal and ventral view, ♀ ; **B**, wing, ♀ ; **C**, abdomen in dorsal and ventral view, ♂ ; **D**, head, ♂ ; **E**, ♂ terminalia. **F–I**, *Ornithomyia* (*Pseudornithomyia*) *hoffmannae* J. Bequaert, Cacahoatán, on *Buteo nitidus plagiatus:* **F**, wing, ♀ holotype; **G**, dorsal and ventral view of abdomen, ♂ allotype; **H**, head, ♂ allotype; **I**, terminalia, ♂ allotype.

parentheses). Columbiformes: *Leptotilla rufaxilla reichenbachii.* Passeriformes (11): *Iridoprocne albiventer* (2); *Notiochelidon c. cyanoleuca* (6); *Progne chalybea domestica* (1); *Stelgidopteryx r. ruficollis* (1); *Xenops r. rutilans* (1).

Ten of the 11 verified records being from swallows (Hirundinidae), the fly is evidently a strict specific parasite of such birds. The records from a pigeon (*Leptotilla*) and an oven-bird (*Xenops*) are either accidental or more probably due to fortuitous contaminations.

Affinities. These are discussed under *O. hoffmannae.* The truly distinctive characters are given in the key. The male terminalia (Fig. 31*E*) are similar to those of *O. hoffmannae.*

Original description of *P. ambigua* (translated from the Portuguese): "Length of body 5 mm., of head and thorax combined 2.5 mm., of wing 5 mm. General color chocolate, a little reddish over hind part of head and ochraceous over humeral callosities. Head generally ochraceous, mostly infuscated or blackish. Antennal processes rather long, with even longer bristles, entirely chocolate, as are also the palpi. Clypeus short, deeply emarginate medially, with whitish pruinosity and ciliae; frontal triangle medially with a small pit connected with the hind margin by a furrow (these depressions seem to vary somewhat); vertex without ocelli, but with a small pit near middle of side margins. Both triangles [of face] somewhat rounded, shiny, like the ocular margins [inner orbits] which are broad and bear a row of ciliae over anterior half. Frons broad, dull portion [mediovertex] somewhat longer than wide, the four sides rather concave. Occiput oblique, covering anterior part of thorax. Thorax with conical humeral callosities, ochraceous at tip, very long, their base resting in a deep emargination of mesonotum; spiracle distinct as a white, pruinose spot. Median notal suture deep, with reddish margins; transverse mesonotal suture effaced medially; the margins of mesonotum form callosities. Scutellum transversely elliptical, on each side with 4 long bristles between anterior and posterior margins, which bear long hairs. Squamular process dark, subconical. Abdomen chocolate color, with many concolorous hairs. Legs chocolate color or ochraceous-gray, with many scattered hairs; anterior femur very thick. Wings bare from base to tip of costa and to cross-veins, also over axillary cell and most of cell located between anal cross-vein, 4th and 5th veins [error for 5th and 6th, as shown by the figure] and hind margin [the figure shows most of 3rd posterior cell bare]. Veins chestnut or blackish, second cross-vein white over most and third over little of its length." The original figures show the scutellum (Pl. 27, fig. 5) and the wing (Pl. 28, fig. 7). I have not seen any of the types of this species, which is easily recognized from the foregoing description. None of the several specimens I saw had as many and as long weak setae near the anterior margin of the scutellum as shown in the original fig. 5, where the artist, it seems, exaggerated their length and number.

Ornithomyia (Pseudornithomyia) hoffmannae, new species

Figs. 31*F–I* and 32

Female. Head seen in front as wide as high, subcircular; interocular face at its narrowest nearly 4 times as wide as an eye, almost twice as wide as length of eye; inner margins of eyes very

slightly converging below; inner orbit about half as wide at mid-length as mediovertex, only slightly narrower at ptilinal suture, mostly smooth and bare, with a single inner row of 2 long and 3 shorter bristles on middle third and a few minute setae on lower third; gena about half as wide as inner orbit, with 4 unequal setae, 1 or 2 very long near the frontal suture; 1 long vertical bristle; postvertex long, semi-elliptical, about $\frac{2}{3}$ the length of mediovertex, the anterior margin and sides forming one even curve; occipital margin nearly straight; surface of postvertex smooth, without traces of ocelli and without pit. Eyes relatively short and narrow, about $2\frac{1}{2}$ times as long as greatest width, occupying only the lower $\frac{1}{3}$ of sides of face. Interantennal area of frons very narrow basally, separated from the lunula by a suture, broadly but deeply emarginate anteriorly, the apical arms forming bluntly pointed, finger-shaped lobes. Palpi short, slender, only about $\frac{1}{5}$ of height of head. Antennae: 1st segment partially divided from the lunula by a suture on the outer side only, bearing 2 short setae; appendage of 2nd segment moderately long and narrow, bluntly pointed, 3 times as long as wide, about as long as frons; inner half and apex with many long bristles. Thorax relatively wide and short; mesonotum about twice as wide as long in the middle; anterior margin deeply concave, enclosing posterior $\frac{1}{3}$ of head; antero-lateral areas forming broad humeral callosities, almost completely divided by a suture from prescutum, produced anteriorly into bluntly pointed lobes bearing many long and short setae, their surface elsewhere with a few long and short setae anteriorly and one long bristle near outer hind margin (2 or 3 bristles in this position in male allotype); mesothoracic spiracle small, placed dorso-laterally in outer hind corner of humeral callosity; mesonotum with a deep median notal suture from anterior margin to scutellum; transverse mesonotal suture deep, fairly broadly interrupted medially; mesonotum mostly bare, except for one long notopleural bristle, 3 very small presuturals, 3 short postalars and 2 moderately long prescutellars on each side; notopleuron with many, mostly long setae over hind third, the outer hind angle short, broadly rounded; integument of dorsum shiny, with a few very fine, superficial wrinkles. Scutellum short and broad, very shallowly, convexly curved behind, with a slight transverse preäpical depression bearing a row of 12 long bristles, in 6 pairs; a few small setae basally on the disk and a dense apical fringe. Sternum as usual in *Ornithomyia;* median lobes of prosternum long, narrowly triangular, with blunt apex. Legs without distinctive features; femora moderately setose, more hairy

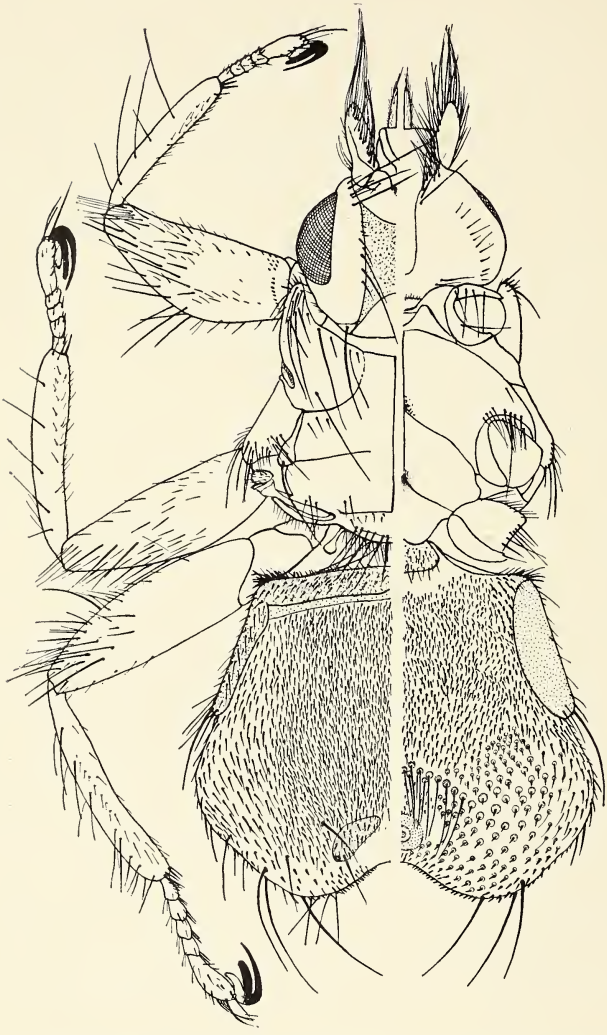

Fig. 32. *Ornithomyia* (*Pseudornithomyia*) *hoffmannae* J. Bequaert, body in dorsal and ventral view, ♀ holotype, Cacahoatán, on *Buteo nitidus plagiatus*. × about 17.

over apical half; tibiae with few long setae spaced in a longitudinal row; mid tibia with 1 and fore tibia with 2 apical spurs; hind tibia with a group of 4 spines at apex. Wing (Fig. 31*F*) short, more narrowed apically than usual, nearly 3 times as long as greatest width, extensively covered with microtrichia over nearly entire 1st and 2nd posterior, and apical third of 3rd posterior cells, as well as narrow tip of axillary cell; veins crowded in antero-basal part of wing; cells narrower and relatively shorter than usual, particularly the 1st and 2nd basal cells; posterior cross-vein basad of anterior cross-vein; anal cross-vein at about mid-length of 2nd basal cell; costa extending a short distance beyond tip of 3rd longitudinal (more than usual in *Ornithomyia*); tip of subcosta not connected with costa (probably abnormal); basal portions of 4th, 5th and 6th longitudinal veins forming thick, short stumps beyond which the veins are very weak and hyaline; costa with many very short setae and, over basal $\frac{1}{4}$, with some very long bristles; other veins bare. Abdomen with a short sclerotized basal tergite continued on each side as a narrow plate, the tergite bearing a few minute hairs and some stronger setae along anterior margin; apices of lateral extensions with one very long, stiff bristle and a few shorter setae; a median pair of small, irregularly oval sclerites near apex, each bearing a few short setae and one long bristle, as well as a spiracle; remainder of dorsum soft, membranous, without sclerites, fairly uniformly covered with minute setae, a few of them longer at sides, and with a few very long, stiff preäpical bristles; no ventral sclerotized areas, except for the lateral extensions of the basal dorsal sclerite; basal half of venter covered fairly uniformly with minute setae; setae of apical half much thicker, each on a raised papilla; the papillae large, knob-like and with long, stiff bristles over the median area some distance basad of anal and genital openings.

Length of head and thorax (from notch of frons to hind margin of scutellum), 2.8 mm.; of wing, 4.5 mm.; width of wing, 1.6 mm. (total length of specimen in alcohol, 4.8 mm.).

Male. Similar to the female, except as follows. Subcosta ending in costa. Abdomen (Fig. 31*G*): a pair of short and broad (transverse), postero-median dorsal sclerites, in close contact medially (homologous with the 3rd median sclerite of *O. fringillina*), each bearing 8 or 9 long bristles at side near hind margin, as well as some small setae; apicad of these, a median pair of smaller, oblique sclerites, each with a spiracle, 3 long bristles and some short setae (homologous with apical pair of female); ventrally without

setigerous knobs, but covered fairly uniformly with short setae, and a few long bristles at apex and sides. Male terminalia (Fig. 31*I*) similar to those of other species of *Ornithomyia,* but the gonocoxites rather broad and short, bearing 3 short bristles and a few minute setae; the lateral plates more sclerotized than usual and with many long bristles. Measurements as in female.

Mexico: Cacahoatán, State of Chiapas, 600 m., 1 female holotype and 1 male allotype, on *Buteo* (*Asturina*) *nitidus plagiatus* (Collector unknown.—Received from Dr. Anita Hoffmann Sandovel). Holotype at Escuela Nacional de Ciencias Biologicas, México, D.F.; allotype at Mus.Comp. Zool., Cambridge, Mass.

Affinities. Although closely related to *O. ambigua* and belonging in the same subgenus, *O. hoffmannae* is easily distinguished by the characters given in the key. The wider face and relatively smaller eyes are particularly striking. The differences in the bristles and setae on the inner orbits, scutellum and abdomen are possibly not fully reliable, as only one pair of the new species is available.

Crataerina v. Olfers, 1816

Crataerina v. Olfers, 1816, De Vegetativis et Animatis Corporibus in Corporibus Animatis Reperiundis Commentarius, **1**, p. 101 (monotypic for *Crataerina lonchoptera* v. Olfers, 1816 = *Ornithomyia pallida* Latreille, 1812).

Crataerhina Speiser, 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40**, p. 555 (emendation of *Crataerina* v. Olfers; same type).

Crataerrhina Bezzi, 1904, Kat. Paläarkt. Dipt. **4**, p. 280 (emendation of *Crataerina* v. Olfers; same type).

Crathaerina Hesse, 1919, Jl. f. Ornithologie, **67**, p. 408 (error for *Crataerina* v. Olfers; in the combination *Crathaerina pallida* "Olivier").

Cratarrhina Jobling, 1926, Parasitology, **18**, No. 3, p. 341 (error for *Crataerina* v. Olfers, with *Oxypterum* Leach as synonym).

Crathaerrhina Hardenberg, 1927, Bijdrage tot de Kennis der Pupipara, p. 35 (error for *Crataerina* v. Olfers).

Crahterina Huzimatu, 1938, Science Repts. Tohoku Imperial Univ., Sendai, (4), Biol., **13**, pt. 1, p. 59 (error for *Crataerina* v. Olfers).

Crathaerhina Eichler, 1939, Zeitschr. Hyg. Zool., **31**, p. 215 (cited as a misspelling of *Crataerina* v. Olfers).

Craterrhina and *Craterhina* Brauns, 1939, Zool. Jahrb., Abt. Physiol., **59**, p. 334, footnote (cited as misspellings of *Crataerina* v. Olfers, according to Eichler, *in litt.*).

Cratoerina [Anonymous], 1951, Nature, London, **167**, p. 937(in the combination *Cratoerina pallida;* error for *Crataerina*).

Oxypterum "Kirby, MS" Leach, 1817 (September), Gen. Spec. Eproboscideous Ins., pp. 3, 5, 7 and 17 [1818, Mem. Werner. Soc. Edinburgh, **2**, pt. 2, pp. 549, 551, 553 and 563] (for *Ornithomyia pallida* "Olivier" [really of Latreille, 1812] and *Oxypterum kirbyanum* Leach, 1817, both one species); 1817 (November), in Brewster's Edinburgh Encyclopaedia, **12**, pt. 1, p. 162 (with brief diagnosis: "ocelli none." Monotypic for *Oxypterum kirbyanum* Leach). Type by designation of Westwood, 1840,

Introd. Modern Class. Ins., **2**, Generic Synopsis, p. 154: *Oxypterum kirbyanum* Leach, 1817 = *Ornithomyia pallida* Latreille, 1812.[34]

Ocypterum Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 234 (either emendation or misspelling of *Oxypterum* Leach, 1817, which spelling is used on p. 229).

Oxcypterum Charbonnier, 1920, Proc. Somersetshire Archaeol. Nat. Hist. Soc., **65**, p. 96 (error for *Oxypterum*).

Anapera Meigen, 1830, Syst. Beschreib. Europ. Zweifl. Ins., **6**, p. 234 (substitute name for *Oxypterum* Leach, 1817, including the same two species; type by present designation: *Ornithomyia pallida* Latreille, 1812).

Chelidomyia Rondani, 1879, Bull. Soc. Ent. Italiana, **11**, p. 15 (for 4 species: *C. pallida* Leach, 1817; *C. melbae* Rondani, 1879; *C. hirundinis* Linnaeus, 1758; and *C. cypseli* Rondani, 1879; with *Stenopteryx* Leach, *Oxypterum* Leach, *Crataerina* v. Olfers, and *Anapera* Meigen as synonyms; type by present designation: *Ornithomyia pallida* Latreille, 1812).

Chelyidomyia Bezzi, 1891, Bull. Soc. Ent. Italiana, **23**, p. 90 (in the combination *Chelyidomyia pallida;* error for *Chelidomyia* Rondani).

Although obviously a variant of *Crataerina, Craterina* Samouelle, 1819 (The Entomologist's Useful Compendium, p. 303), is not included in the foregoing synonymy, because it was used only in the combination *Craterina hirundinis* L., a species of *Stenepteryx*. Later English authors (Curtis, 1826, 1829; Kirby and Spence, 1828; Stephens, 1829; Westwood, 1840; Walker, 1849) all seem to have used *Craterina* in the same sense, for *Stenepteryx hirundinis;* although some of them may have confused *S. hirundinis* and *Crataerina pallida.*

Generic Characters. Parasites of birds, with reduced, nonfunctional wings, not metallic-greenish; but a dull-green pigment in the haemolymph may show through the integument in life. Head as high as wide or higher, deeply inserted between the prominent humeral callosities. Ocelli absent. Eyes small, occupying dorsolaterally $\frac{1}{2}$ of the height of the head or less, each less than $\frac{1}{2}$ the width of the interocular face, with many minute but distinct ommatidia. Postvertex and frons far apart. Upper part of postvertex a thin, translucent plate along the strongly arched occipital margin, which covers anterior margin of prescutum. Suture between lunula and interantennal area of frons usually lacking or incomplete, rarely complete; lunula without median pit or depression, longer than interantennal area; apical arms of frons rather short, slightly diverging; when the proboscis is fully extended, the sclerotized clypeus, bearing a few setae, is visible in certain species (Figs. 34*J; C. pallida*), but not in others. Antennae medium-sized, about as in *Ornithomyia:* 1st segment with 2 or more setae, separated by a complete or incomplete suture from lunula; 2nd

[34] The binomial *Oxypterum kirbyanum* was also published by Kirby and Spence, 1817 (month ?), Introduction to Entomology, **2**, [p. 350] in the explanation of Pl. 5, fig. 1. The plate itself is dated January 1, 1817, but bears no name and probably appeared much before the Explanation.

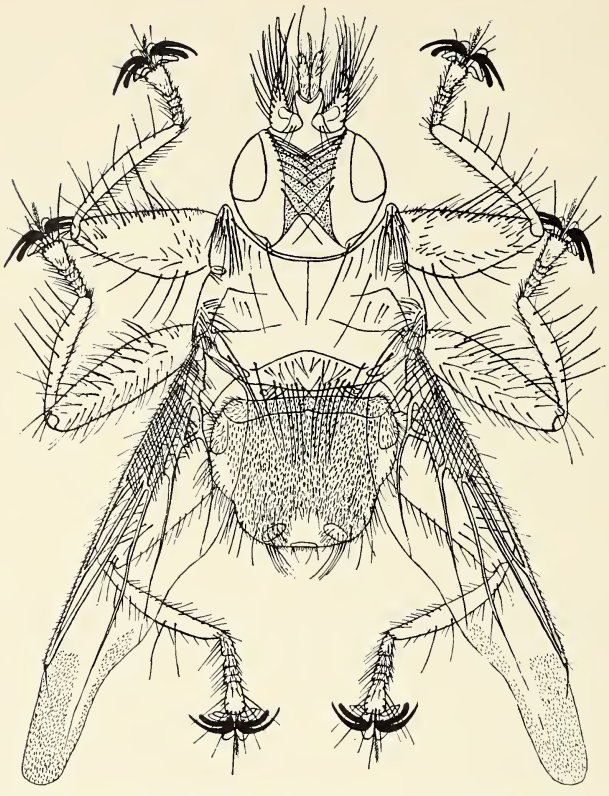

Fig. 33. *Crataerina seguyi* Falcoz, ♀, Tofo, on *Notiochelidon cyanoleuca patagonica*. × about 17.

segment with a moderately long and narrow appendage, gradually narrowed from the base to the blunt point, which does not reach tips of palpi; both appendages diverging, leaving apical arms of frons and palpi fully exposed; arista flattened, gradually widened and slightly spatulate, the surface with very fine ridges spreading fan-like from the base. Palpi well-developed. Thorax short and broad, sometimes twice as wide as long in the middle, very flat, depressed or even slightly concave in the center. Pronotum very short, not visible from above. Humeral callosities large, strongly produced forward as blunt, triangular lobes, extending along upper $\frac{1}{3}$ of head to near upper eye margins; posthumeral suture either lacking or short and restricted to side; prothoracic spiracle medium-sized, entirely dorsal, close to outer hind margin of callosity. An-

terior margin of prescutum deeply and evenly curved inward, semi-elliptical; transverse mesonotal suture curved forward medially where it is very briefly interrupted, placed at hind third of mesonotum; anterior ridge of parascutellum fused with mesoscutum; median notal suture distinct anteriorly, not reaching scutellum; notopleuron either completely fused with prescutum or set off posteriorly only by a slight depression; dorsal portion of anepisternum broadly lathe-shaped, with blunt outer hind edge, divided on outer side only by a crested suture from humeral callosity, either fused with mesonotum or separated from it by a weak suture. Scutellum short, but broad; scuto-scutellar suture convexly curved forward medially; hind margin very slightly convex or nearly straight, somewhat raised and set off by a narrow, transverse, preäpical groove. Metathoracic pleurotergite moderately and uniformly convex, not visible from above. Halteres present, well developed. Sternum (Fig. 34*A*): basisternum of prothorax separated from mesosternum by a complete suture, divided into 2 short, broadly triangular, bluntly conical intercoxal lobes; mesosternum, metasternum and longitudinal sternal suture as in *Ornithomyia;* no metasternal spur near hind coxa. Metathoracic spiracle placed as in *Ornithomyia* and *Ornithoctona.* Legs long, very robust; femora much swollen; tibiae flattened, relatively narrow; tarsal segments 1 to 4 broad, short; hind basitarsus shorter than in *Ornithomyia,* at most twice the length of 2nd segment, beneath with many spine-like bristles partly in a basal transverse row; tips of all tibiae normal; tibial spurs replaced by an apical row of 2 to 5 short, stiff bristles. Claws (Fig. 34*F*) symmetrical in each pair, deeply split (seemingly tridentate): terminal (outer) tooth long, very slender, sharp; inner tooth shorter, flattened, blade-like, with pointed or rounded tip; in addition a slender, tooth-like basal "heel," slightly shorter than inner tooth; 2 pad-like pulvilli and a long, feathered empodium. Wing (Figs. 34*B–C*) either of about normal length or somewhat shortened, always partly narrowed; basal $\frac{1}{2}$ to $\frac{2}{3}$ much wider than the abruptly narrowed apical portion, which varies in length even in the same species. Venation variable, even intraspecifically, hence not reliable for specific diagnosis; when most normal, nearly as complete as in *Ornithomyia;* subcosta thin, complete; longitudinal veins crowded in anterior half and cross-veins moved to basal third of wing, more so in certain species; some veins thickened or coalescent, partly obliterating certain cells, or supernumerary veins appear; costa covered with fine, short setae and a dense row of many long bristles reclining over the wing;

one stiff, long bristle at tip of costa (often broken off); other veins bare; membrane mostly bare, in some species the narrowed tip with very small microtrichia; 1st basal cell (when normal) longer than 2nd; anal cell about half the length of 2nd basal, with acute upper apical angle; posterior basal cross-vein sometimes partly aborted; alula completely fused in most cases with membrane proper, the hind base of wing unusually wide basad of anal cell (occasionally a short notch marks the limit of the alula); calypteres rudimentary; halteres present, small. Abdomen: dorsum in some species with, in others without unpaired, small, median sclerites behind the fused basal pleurotergites; in all species posteriorly with preäpical tergites, one pair in female, two pairs in male (sometimes fused in a pair); ventrally with only a short, semi-elliptical basal sternite; no striated median, dorsal area. Body very setulose or bristly, particularly on 2nd antennal segment, humeral callosities, anepisternum, scutellum, legs and abdomen; mesonotum and sternum with few setae; 9 or 10 orbital bristles in one regular, continuous row from edge of frontal suture to about mid-height of face; 1 vertical bristle (exceptionally 2); 1 notopleural bristle on a well-defined lobe; 5 or 6 pairs of long bristles on scutellum in 1 or 2 irregular preäpical rows, in addition to scattered setae on the disk. Male terminalia as in *Ornithomyia* and *Ornithoctona;* gonocoxites reduced to a pair of rudimentary lobes each bearing 2 bristles.

The puparium of *C. pallida* (Figs. 34*G–I*) was described by Johnsen (1948, p. 285, fig. 9). According to specimens from swifts' nests in London, sent by Mr. G.E. Woodroffe, it is very broadly oval or nearly elliptical in outline, slightly depressed and equally convex dorsally and ventrally, with the side edges very broadly rounded, about 3.8 mm. long, 3.4 mm. in greatest width and 2.8 mm. thick. The posterior cap bearing the peripneustic lobes is scarcely raised, not notched medially, about as high as wide, hexagonal with broadly rounded angles. The relatively few spiracular pores are arranged in a curve like an irregular question-mark on each of the six radiating areas of the cap, which are not set off by depressions. The integument is bare, smooth, with a microscopic maze of very fine engraved lines. At the anterior end, the semi-circular seam is fairly well marked, but the circular seam is distinct only at the sides where it meets the semi-circular seam. A few puparia I have seen of *C. seguyi* scarcely differ from those of *C. pallida,* except in size.

Crataerina occurs in both the Old and New World. It is most

widely distributed in the Old World, where some 8 species have been described; but how many of these will eventually be retained as valid is uncertain. The only species known from America is strictly tropical.

Crataerina and *Stenepteryx* Leach (1817) are very closely related and there is a question whether they should be kept as distinct genera. If they were combined, *Stenepteryx* could be treated as a subgenus of *Crataerina.* The single known *Stenepteryx, S. hirundinis* (Linnaeus), is a strictly Palearctic parasite of Hirundinidae (Part I, p. 316). It appears to be somewhat less specialized than the species of *Crataerina,* from all of which it differs in the relatively broader and shorter head (Fig. 4*D*), the proportionately larger eyes, the smaller postvertex, the slightly less aberrant venation, as well as in the characters of wings and ocelli mentioned in the key to the genera. These peculiarities are of minor importance and, among the Hippoboscidae in general, of specific rather than generic value.

Crataerina seguyi Falcoz

Figs 33 and 34*A–F*

Crataerina seguyi Falcoz 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 53, fig. 8 (♂; no host. Peru: Arequipa. Type at Paris Mus.). J. Bequaert, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6 (Venezuela). Schuurmans Stekhoven, 1952, Beiträge zur Fauna Perus, **3**, Wissensch. Bearbeit., pp. 95 and 101.

Crataerina segugy J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (for 1950), p. 9 (error for *C. seguyi*).

Distribution and Specimens Examined. Colombia: Bogotá, ♀ on *Notiochelidon murina* (Hno. Apolinar-María); La Picota near Bogotá, ♀ and ♂ from the eaves of a house (Hernando and Ernesto Osorno M.); Piedecuesta, Depto. Santander Sur, on *Notiochelidon murina* (M.A. Carriker, Jr.).

Venezuela (recorded by Anduze, Pifano and Vogelsang, 1947, after my determination): Apartaderos, State of Mérida, 3320 m., ♂ bred from puparium found in a swallow's nest (P. Anduze).

Peru (recorded by Falcoz, 1930): Tarma, Depto. Junín, 3000 m., Jan. 10, ♂ on *Notiochelidon murina* (W. Weyrauch); Arequipa (type ♂ at Paris Mus.); Culluhay, Valle Chanchamayo, 3500 m. (J. Ortiz de la Puente).

Argentina: Tunuyan, Mendoza, ♀ and ♂ on *Notiochelidon cyanoleuca patagonica,* March 24, and ♀ on *Alopochelidon fuscata,* March 29 (A. Wetmore); Los Médanos, Hualfín, Catamarca, ♀, ♂

and 2 puparia, on *Notiochelidon cyanoleuca patagonica,* Oct. 4, and ♀ on *Alopochelidon fuscata,* Oct. 4 (S. Pierotti).

Chile: El Recreo, ♀, Jan. 29 (A. Faz); Putre, Arica, 3550 m., on *Notiochelidon cyanoleuca patagonica* (D. Barros); Tofo, ♀ and ♂ on *Notiochelidon cyanoleuca patagonica* (T. Hallinan).

C. seguyi will probably be recognized as a common South American fly when the ectoparasites of swallows are more carefully studied. Presumably it does not extend north or west of the Isthmus of Panama.

Known Hosts of *O. seguyi* (verified individual records in parentheses). Passeriformes (9 and 1 unidentified swallow): *Alopochelidon fuscata* (2); *Notiochelidon cyanoleuca patagonica* (4); *N. murina* (3).

Bionomics. All known records being from swallows (Hirundinidae), there can be no doubt that these birds are the normal breeding hosts of the American *C. seguyi.* This is most remarkable, as in the Old World the genus *Crataerina* is specific of swifts (Apodidae in the order Apodiformes; see Part I, pp. 267–268 and 316). The few trustworthy European records of *C. pallida* from swallows or other birds are certainly due to accidental straying. It is difficult to account for the different choice of hosts in the two Hemispheres, particularly as numerous presumably suitable swifts are available in the New World also. The Recent species of *Crataerina* may be survivors of two ancestral groups which evolved independently in the two Hemispheres from *Ornithomyia*-like parasites of Hirundinidae, similar to the *Ornithomyia biloba* group of the Old World and the subgenus *Pseudornithomyia* of the New. The New World species kept to the ancestral swallow hosts, while in the Old World they shifted to swifts, becoming somewhat more specialized as a result. The New and Old World species are now obviously congeneric, so that this may be a case of parallel or convergent evolution. However, an alternative explanation is perhaps more probable. The American *C. seguyi,* seemingly less evolved than its Recent congeners, may be the sole survivor of a more primitive and world-wide parasite of swallows, which in the New World was more conservative and remained faithful to the original type of hosts. In the Old World, a more prolific evolution produced species better adapted to the speedier and more aërial swifts, the shift from swallows to swifts possibly induced by a relative abundance of swifts at the time evolution of the flies was most active.

Two apparently normal, black puparia, found with adults associated with *Notiochelidon c. patagonica,* at Los Médanos, scarcely

differ from those of *C. pallida,* as described above, except in size. The larger one is 2.8 mm. long, 1.9 mm. wide, and 1.7 mm. thick.

Affinities. The following notes supplement the original description, which was admittedly incomplete.

Female. Head relatively shorter than in *C. pallida,* about as high as wide and nearly circular. Eyes somewhat larger than in *C. pallida.* Interantennal area of frons much narrower than in *C. pallida,* superficially divided from lunula by a slight depression (deeper at sides), without suture. No trace of clypeus in the membranous area connecting the apical notch of frons with base of palpi. Antennae: 1st segment completely divided by a weak suture from lunula, with 2 short setae; 2nd segment narrower and more pointed than in *C. pallida,* though blunt at tip, with fewer and shorter bristles. Humeral callosities shorter and broader than in *C. pallida,* with a short posthumeral suture; notopleuron fused with mesoscutum; dorsal portion of anepisternum completely divided from mesoscutum, its outer hind edge not projecting (markedly produced in *C. pallida*). Scutellum longer than in *C. pallida;* scuto-scutellar suture more arched. Sternum (Fig. 34*A*) with the suture between basisternum of prothorax and mesosternum very fine. The narrowed part of the wing (beyond tip of costa) varies from $\frac{1}{6}$ to $\frac{1}{4}$ of the total length; it was shorter than average in Falcoz' type; the transition between the narrow tip and the broader section is more gradual than in most other species of the genus. Some variations in venation are shown in Figs. 33 and 34*B–C,* but there are many others; subcosta (not shown by Falcoz) present, but very thin. Microtrichia present in the narrow apical area, extending only a short distance basad of tip of costa. Abdomen dorsally without median sclerites between the broad basal sclerotized area and the pair of small preäpical sclerites. Length of wing 3.2 to 3.6 mm.; from tip of apical arms of frons to hind margin of scutellum, 1.8 to 2.2 mm. The smallest known species of the genus.

Male. Agreeing with female except as follows: Abdomen (Fig. 34*D*) dorsally with a short, broad, transverse, slightly curved, median sclerite, bearing several long bristles in an irregular row; apicad of this with the usual pair of small, oblique sclerites, each bearing a long bristle and a spiracle near the outer margin. Male terminalia without peculiarities. Size as in female.

The wings of the ♀ from Tofo, shown in Fig. 33, have the normal venation. In Falcoz' type the 2nd basal cell was abnormally short. In Fig. 34*B* the 2nd basal cell is obliterated over the apical half

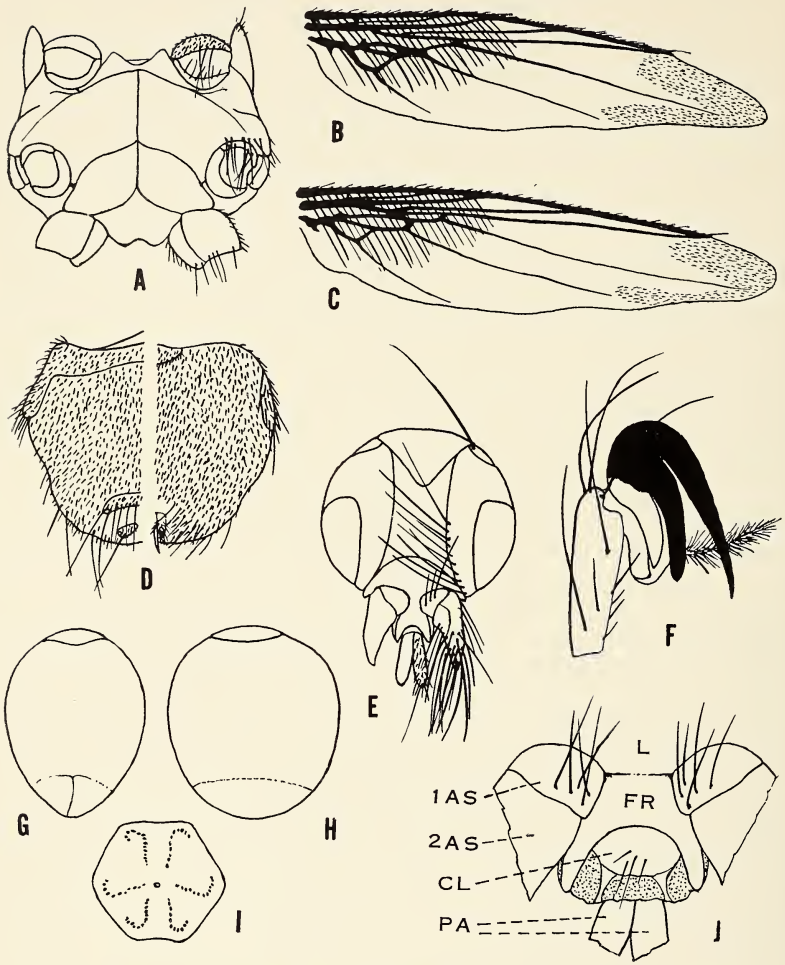

Fig. 34. **A–F**, *Crataerina seguyi* Falcoz; **A, D, E** and **F** from Tarma, on *Notiochelidon murina;* **B**, from Tunuyan, on *Notiochelidon cyanoleuca patagonica;* **C**, from Putre, on *N. c. patagonica:* **A**, sternum, ♂; **B**, wing, ♂; **C**, wing ♀; **D**, abdomen dorsally and ventrally, ♂; **E**, head, ♂; **F**, distitarsus and claw of hind leg, ♂. **G–J**, *Crataerina pallida* (Latreille): **G–I**, puparium, London, in side view (**G**), from above (**H**), and respiratory lobes (**I**); **J**, lower frontal area and clypeus, ♀, Waldheim, Germany: *1AS* and *2AS*, 1st and 2nd antennal segments; *CL*, clypeus; *FR*, frons; *L*, lunula; *PA*, palpi.

and narrowed over the remainder by thickening and fusion of the 4th and 5th longitudinals; this occurred in both wings of the specimen; but a ♀ taken with it on the same host had a normal venation in both wings. In Fig. 34*C* the 1st basal cell is divided by a broad fusion of the 3rd and 4th longitudinals; again this was present in both wings. This ♀ from Putre also has some traces of green pigment in the veins.

Original description of *C. seguyi* (translated from the French): *Male.* "Length of body, from base of antennae to tip of abdomen, 4 mm.; of wings 3.3 mm.; width of wings, 1 mm. Color fulvous-olive. Head: parafrontal [orbital] and antennal bristles rather long, black; antennae shaped as in *C. pallida;* frontal vitta [mediovertex] slightly narrowed behind; occipital triangle [postvertex] very distinctly angular in front. Wings: bristles of costa moderately long over basal third, short over remainder of length; distal part of wing narrowed for about one-sixth of total length, apex broadly rounded; tip of 4th longitudinal (M_{1+2}) extending very slightly beyond end of costa; inner margin of wing wavy beyond mid-length; 2nd basal cell narrow, a little longer than anal cell. Owing to the dry condition of the type, it is not possible to see the details of structure of the abdomen. This species is clearly distinct from its congeners in the small size, the shape of the occipital triangle [postvertex], and the shape and peculiar venation of the wings." I have examined the type at the Paris Museum in 1951.

Myiophthiria Rondani

Myophthiria Rondani, 1875, Ann. Mus. Civ. Stor. Nat. Genova, **7**, p. 464 (monotypic for *Myophthiria reduvioides* Rondani, 1875).

Myiophthiria Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 153 (author's emendation of *Myophthiria;* same type).

Myiophteria Galli-Valerio, 1909, Centralbl. Bakt. Parasitenk., Abt. I, Originale, **51**, p. 539 (in the combination *Myiophteria reduvioides* Rondani; error for *Myiophthiria*).

Myiocoryza Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 155 (monotypic for *Myiophthiria lygaeoides* Rondani, 1878).

Generic Characters. Parasites of birds, with greatly reduced, non-functional wings, not metallic-greenish, but sometimes with a dull-green pigment in the haemolymph showing through the integument in life. Head (Figs. 35*C* and 36) deeply inserted between humeral callosities, as high as wide to much higher, subcircular or vertically elliptical. Ocelli absent. Eyes very small, occupying dorsally $\frac{1}{4}$ or less of height of head, each less than $\frac{1}{6}$ of width of interocular face, placed far from frons and much farther from postvertex, with several minute, but distinct ommatidia. Postvertex and frons far apart. Occipital margin moderately to strongly arched, covering anterior margin of prescutum. Frons unusually long, occupying about $\frac{1}{2}$ or more of height of head; interantennal area very broad; apical portion broadly emarginate, with slightly diverging or nearly parallel apical arms; lunula often with a minute pit close to the more or less developed or obsolete suture

separating it from interantennal area. Inner orbits very wide, particularly in upper half of head, where they narrow the mediovertex. Clypeus sometimes present as a minute sclerite in the rostrum membrane between the edge of the frontal notch and the bases of the palpi. Soft mediovertex wrinkled by 8 to 10 parallel, longitudinal, shallow grooves. Antennae medium-sized, not much larger than in *Ornithomyia:* 1st segment partly fused with lunula, bearing several long setae; 2nd segment with a moderately long and wide appendage, bluntly pointed or broadly rounded at apex, not or barely reaching tips of palpi; both appendages scarcely diverging, but leaving apical arms of frons and palpi fully exposed; arista flattened, elongate spatulate. Palpi well developed, but short. Thorax short, broad, nearly twice as wide as long in the middle, very flat, depressed or even somewhat concave medially. Pronotum very short, not visible from above. Humeral callosities large, broad, either bluntly pointed or lobular, extending along upper $\frac{1}{3}$ of head. Posthumeral suture very short, but deep at extreme sides, deflected backward. Prothoracic spiracle large, dorsal, close to outer hind margin of callosity. Anterior margin of prescutum very deeply and evenly curved inward (concave), almost semi-circular; transverse mesonotal suture vestigial at sides only or lacking, when present placed far back at about hind fourth of mesonotum; anterior ridge of parascutellum fused with mesoscutum; median notal suture either lacking or incomplete; notopleuron and dorsal portion of anepisternum fused with prescutum; anepisternum divided by a weak suture from humeral callosity, its outer hind edge prominent, but broadly and evenly rounded. Scutellum very wide and short, transverse; hind margin and deep scuto-scutellar suture either slightly arched or nearly straight, sometimes almost parallel; disk with a superficial, transverse preäpical groove. Metathoracic pleurotergite a short, conical, blunt protuberance. Halteres present, well developed. Sternum (Fig. 35*A*) : basisternum of prothorax and mesosternum either fused or divided by a very superficial suture; basisternum forming 2 short, broadly triangular, bluntly rounded intercoxal lobes; mesosternum, metasternum and longitudinal sternal suture as in *Ornithomyia;* no metasternal spur near hind coxa. Metathoracic spiracle between pleurotergal protuberance and hind coxa. Legs long, robust, more so in the American than in the Old World species; femora uniformly thick throughout; tarsal segments 1 to 4 broad, short; hind basitarsus as in *Crataerina;* tips of all tibiae normal; tibial spurs replaced by several short, stiff bristles. Claws (Fig. 35*F*) sym-

metrical in each pair, more deeply divided than in *Crataerina* (seemingly tridentate); inner tooth nearly as slender as and little shorter than outer (terminal) tooth; basal "heel" also slender, tooth-like, almost as long as inner tooth; 2 broad, pad-like, bare pulvilli and a long, feathered empodium. Wing (Figs. 12*A*, 35*B* and *G*) reduced to a short pad, at most twice as long as wide and often only about as wide as long; venation reduced to a few thickened veins crowded in anterior half, owing in part to fusion of some of the original veins, most of which cannot be traced; costa with many long, stiff bristles; other veins usually bare; membrane rather tough, bare; alula fused with base of wing or absent; no calypteres. Abdomen: dorsally with only the basal transverse sclerite in some species; in others in addition with a pair of small preäpical sclerites and 1, 2 or 3 mostly small, median sclerites; ventrally with only the small median basal sclerite; no striated median dorsal area. Body unusually bristly, more so than in any other hippoboscid, hence more spider-like; bristles particularly long and numerous on palpi, antennae, inner orbits, sides of thorax dorsally, scutellum and legs; abdomen densely setulose, with many longer bristles along the sides; a group of 3 or more long vertical bristles; 1 notopleural bristle; scutellum with one or more irregular rows of preäpical bristles across the width, the disk without short setae. Male terminalia (Fig. 35*E*) as in *Crataerina;* gonocoxites reduced to very short, bristly lobes; penis valves (claspers) heavy, rod-like as usual in Hippoboscidae. Puparium unknown.

As here understood, *Myiophthiria* comprises all known 4 species of bird-flies with the wings reduced to short pads, all specific parasites of swifts (Apodidae) and swallows (Hirundinidae), and among the most specialized of the Hippoboscidae. They occur in the Oriental Region, the Pacific area, western North America and northern South America, and seem to form 2 natural groups, here given subgeneric rank. *Myiophthiria,* proper, comprising the Old World species, *M. reduvioides* Rondani (1875) (= *capsoides* Rondani, 1878) and *M. lygaeoides* Rondani (1878), is the less specialized type. As compared with the American subgenus *Brachypteromyia,* the dorsal thoracic sutures are more distinct; the scutellum longer and narrower; the legs more slender, with narrow tibiae; the body less hirsute, the primitive muscoid chaetotaxy being easier to trace; the wing pads longer and narrower, with more of the venation retained; and the dorsum of the abdomen with at least a pair of distinct preäpical and sometimes also with median sclerites.

Subgenus *Brachypteromyia* Williston, 1896

Brachypteromyia Williston, 1896, Ent. News, **7**, p. 184 (monotypic for *Brachypteromyia femorata* Williston, 1896 (=*Anapera fimbriata* Waterhouse, 1887).

Brachyptomyia Speiser, 1907, Ent. News, **18**, p. 104 (error for *Brachypteromyia*).

Brachypteromia Aldrich, 1907, Jl. New York Ent. Soc., **15**, p. 6 (error for *Brachypteromyia*).

Brachypteromya Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6 (error for *Brachypteromyia*).

Differs from *Myiophthiria*, proper, in the dorsal sutures of the thorax being either incomplete, vestigial or lacking; the broader and shorter scutellum; the more hirsute body and legs; a further reduction of the abdominal sclerites; the more robust legs, with thicker femora and wider, flatter tibiae; and the shorter and broader wings, with even more reduced venation.

Ferris (1928*c*) pointed out that *Brachypteromyia* did not differ sufficiently from *Myiophthiria* to be recognized as a distinct genus and he regarded the former as purely a synonym of the latter. It seems useful to retain *Brachypteromyia* with subgeneric rank for the two American species, as they appear to be more evolved than those of the Old World.

Key to American Species of *Myiophthiria*

1. Head $1\frac{1}{2}$ times as long (from apex of frons to occipital margin) as its greatest width. Humeral callosity wide throughout, lobular, broadly rounded at tip. Larger species, 5.5 mm. or more from apex of frons to hind margin of scutellum ..... *M. neotropica*

   Head scarcely longer than its greatest width. Humeral callosity triangular, narrowed anteriorly to a blunt point. Smaller species, at most 3.5 mm. from apex of frons to hind margin of scutellum ..... *M. fimbriata*

Myiophthiria (*Brachypteromyia*) *fimbriata* (Waterhouse)

Figs. 35*A–F*

Anapera fimbriata Waterhouse, 1887, Proc. Zool. Soc. London, p. 164, fig. (on p. 163) (no sex. New Mexico: Fort Wingate, on "*Cypselus melanoleucus* [*Aëronautes s. saxatilis*]. Type in Brit. Mus.). Shufeldt, 1887, The Ibis, London, (5), **5**, p. 157, footnote; 1894, The Auk, **11**, p. 186. Aldrich, 1923, Insecutor Inscitiae Menstruus, **11**, p. 78.

Brachypteromyia fimbriata Speiser, 1899, Wien. Entom. Zeitg., **18**, p. 202, footnote; 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40**, p. 555; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Bezzi, 1916, Riv. di Sci. Nat. "Natura," **7**, p. 179. Austen, 1926, Parasitology, **18**, pt. 3, p. 359 (♀ type). J. Bequaert, 1943, Psyche, **49**, (for 1942), p. 112 (♀ ♂).

Brachyptomyia fimbriata Speiser, 1907, Ent. News, **18**, p. 104.
Brachypteromia fimbriata Aldrich, 1907, Jl. New York Ent. Soc., **15**, p. 6.
Myiophthiria fimbriata Ferris, 1928, Pan-Pacific Entom., **4**, p. 140, figs. 1–2 (♀ ♂. Arizona: Tuba, on *Aëronautes s. saxatilis*).
Brachypteromyia femorata Williston, 1896, Ent. News, **7**, p. 185 (♂. Wyoming: on *Aëronautes s. saxatilis.* Present location of type unknown). Bezzi, 1900, Rendic. Ist. Lombardo Sc. Lett., (2), **33**, p. 522. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656.

Distribution and Specimens Examined. United States. Arizona (recorded by Ferris, 1928): Tuba City, Coconino Co., on *Aëronautes s. saxatilis* (V. Tanner). — Colorado: without precise locality, on *Aëronautes s. saxatilis* (Joel Allen, May, 1882); Golden, Jefferson Co., on *Aëronautes s. saxatilis* (G. Rohwer). — Nebraska: Lincoln, Lancaster Co., on *Tachycineta thalassina lepida,* Aug. 29. — New Mexico (recorded by Waterhouse, 1887): Fort Wingate, McKinley Co., ♀ holotype of *fimbriata* (Brit.Mus.) and 2 ♀ topotypes (? or cotypes, at U.S.N.M.), on *Aëronautes s. saxatilis* (R.W. Shufeldt); El Morro, 40 miles S. of Gallup, McKinley Co. (H.S. Barber). — Utah: Kanab, Kane Co., on *Aëronautes s. saxatilis* (W.J. Breckenridge). — Wyoming (recorded by Williston, 1896). — Also on *Nephoecetes niger borealis,* without locality (from Osten Sacken Coll. — M.C.Z.).

At present *B. fimbriata* is not known outside the western United States. As the known hosts, *Aëronautes, Nephoecetes* and *Tachycineta,* all occur south of the United States boundary, the fly will no doubt be found in Mexico.

Bionomics. *M. fimbriata* has been taken most often on 2 species of swifts (Apodidae): *Aëronautes saxatilis* (5 verified records, on the typical race) and *Nephoecetes niger* (1 verified record, on *N. n. borealis*). Swifts may be regarded as the true breeding hosts. Possibly it breeds also on some of the swallows (Hirundinidae), as suggested by the one record from *Tachycineta thalassina lepida.*

Affinities. It is generally agreed that *A. fimbriata* and *B. femorata* were based on one and the same species. The types of both were taken from the same host. The synonymy was first suggested by Speiser (1900) and definitely recognized by Ferris (1928*c*).

The following differences between *M. fimbriata* and *M. neotropica* supplement the key. Inner orbit narrower, about as wide as mediovertex; orbital bristles more numerous, in several irregular rows, spread over a wider area, which expands both at upper and lower ends; 2 to 4 vertical bristles in upper corner, which is somewhat set off from remainder of side of face. Postvertex shorter

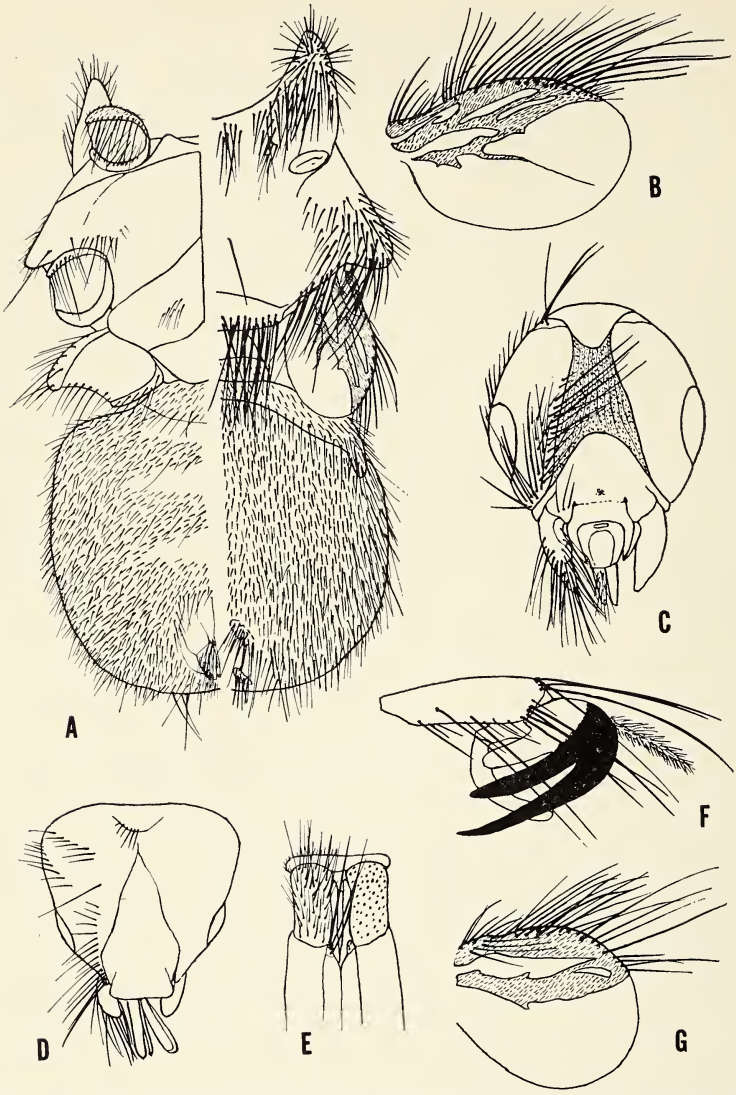

Fig. 35. **A–F**, *Myiophthiria* (*Brachypteromyia*) *fimbriata* (Waterhouse); **A**, **D** and **E**, from Colorado, on *Aëronautes s. saxatilis;* **B**, **C** and **F**, on *Nephoecetes niger borealis:* **A**, thorax and abdomen ventrally and dorsally, ♂; **B**, wing, ♂; **C**, head, ♀; **D**, head ventrally, ♂; **E**, ♂ terminalia; **F**, distitarsus and claw of hind leg, ♂. **G**, *M.* (*B.*) *neotropica* J. Bequaert, wing, ♂ holotype, Galipan, on *Aëronautes m. montivagus.*

and broader, more semi-elliptical, much shorter than mediovertex. Eye small, occupying about $\frac{1}{3}$ of upper side of head, seen from above about twice as long as wide, about twice as far from post-vertex as from frons. Antennal appendage longer and narrower, about $2\frac{1}{2}$ times as long as greatest width, widened about mid-length, bluntly rounded at tip. No trace of longitudinal median notal suture anteriorly nor of transverse mesonotal suture. Scutellum slightly longer and narrower; scuto-scutellar suture more arched. Pleurotergal protuberance barely indicated. Wing (Fig. 35*B*) longer, narrower and more elliptical, about $1\frac{1}{2}$ times as long as wide; rudimentary venation more distinct, very variable (compare Fig. 35*B* with Ferris, 1928*c*, p. 141, fig. 2). The posterior sclerites are rudimentary: in the male a pair of very small preäpical, dorsal sclerites bear several long bristles; basad of these a transverse group of bristles is set off on each side on a weakly sclerotized, ill-defined area; these sclerotized areas are only indicated in the female by patches of long bristles. Smaller than *M. neotropica:* length from tips of apical arms of frons to hind margin of scutellum, 3.2 to 3.4 mm.; of wing, 1 mm.

Original description of *A. fimbriata:* "Smoky yellow, with the abdomen brown; the epistome pale yellow. The general form and structure are those of *A. pallida,* but it is considerably larger. The antennae are beset with long black erect hairs or setae in front of the eye, continued posteriorly along the orbits of the eyes on each side of the middle opaque disk. This fringe exists, but in a much less degree, in *A. pallida.* The triangle on the vertex is longer than broad, and not transverse as in *A. pallida.* There is a series of black setae along the posterior margin of the head. The thorax is of the same form and with the same black setae as in *A. pallida,* but they are stronger and more conspicuous. The rudimentary wings are pale smoky yellowish, about as long as broad, with numerous black setae on the costal area. The abdomen is somewhat round, clothed with black hair, which is very short on the disk, long at the sides and apex; the base has a transverse arcuate fold; the disk is deeply impressed, but, although this is nearly the same in both examples, it is possibly the result of contraction. The legs are as in *A. pallida,* beset with black hairs. Length 5 lines [10.5 mm.]." The type is a female, now at the British Museum, where I saw it in 1951. According to Dr. G. B. Fairchild (*in litt.,* 1953), the small, triangular wing pad, difficult to measure, is about 1 mm. long.

Original description of *B. femorata:* "Brownish yellow in color, the abdomen, save the basal portion, appearing black beneath the dense black hair. Hair everywhere black and usually long; on the top of the head it forms two long rows, beginning on either side of the base of the antennae and convergent posteriorly. On the sides of the mesonotum it is somewhat tuft-like in front and behind, and forms a long, dense row on the scutellum; the hair of the narrow portion of the abdomen very abundant and shorter; that of the femora rather sparse. The color of the claws, save the basal tooth, is black. Length 6 mm." Thus far I have been unable to locate the whereabouts of this type, which Williston stated to be a male.

Myiophthiria (*Brachypteromyia*) *neotropica* (J. Bequaert)
Figs. 35*G* and 36

Brachypteromyia neotropica J. Bequaert, [1942 (December 31), Bol. Entom. Venezolana, **1**, pt. 4, p. 83, *nomen nudum*] 1943 (February), Psyche, **49**, (for 1942), pts. 3–4, p. 113, fig. 1 (♂. Venezuela: Galipán, close to Pico del Avila, 2000 m., Distrito Federal, on *Aëronautes m. montivagus.* Type at Mus.Comp.Zoöl., Cambridge, Mass.). Beebe, 1949, Zoologica, New York, **34**, pt. 2, p. 61 (Venezuela: Rancho Grande, on *Aëronautes m. montivagus*).

Brachypteromya neotropica Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6.

Distribution and Specimens Examined. Venezuela (recorded by Beebe, 1949): Galipán, close to Pico del Avila, 2000 m., Distrito Federal, ♂ holotype, on *Aëronautes m. montivagus;* Rancho Grande, between Maracay and Ocumare-de-la-Costa, 3500 ft., State of Aragua, 1 ♂ on *Aëronautes m. montivagus* (W. Beebe).

Original description of *B. neotropica* (revised): *Male.* Head broadly oval, about $1\frac{1}{4}$ times as long (from tips of apical arms of frons to occipital margin) as greatest width. Interocular face at its narrowest nearly 6 times as wide as an eye; inner orbit very wide (near postvertex slightly wider than mediovertex), conspicuously but gradually narrowed downward, the inner margins strongly diverging toward frons; orbital bristles in 2 or 3 irregular rows, crowded in a narrow strip near inner margin and extending over anterior $\frac{3}{4}$ of inner orbit; a fringe of long bristles at edge of outer orbit, near and behind eye; 6 or 7 vertical bristles in upper corner of each inner orbit. Postvertex slightly shorter than mediovertex, flat, triangular with obtuse and ogival lower angle and laterally produced upper corners; occipital margin nearly straight; surface smooth, without rudimentary ocelli, pits or depressions. Frons long and broad, slightly shorter than its distance from occipital margin; suture between interantennal area and lunula superficial; interantennal area very broad and short at base, the apical arms short, enclosing a broad but shallow inward curve; lunula with a minute and shallow median pit close to interantennal suture. Mediovertex well developed, much broader anteriorly, with wide antero-lateral extensions separating genae from lunula. Eye small, nearly elliptical, occupying a little over $\frac{1}{3}$ of upper side of head, seen from above about twice as long as wide, nearly twice as far from postvertex as from frons. Palpi about as long as frons, but as a rule mostly retracted within the rostrum membrane. Antennae medium-sized: 1st segment fused with lunula, bearing 3 to 6 long setae in inner anterior corner; appendage of 2nd segment nearly twice as long as wide, flat, broadly rounded at apex, densely

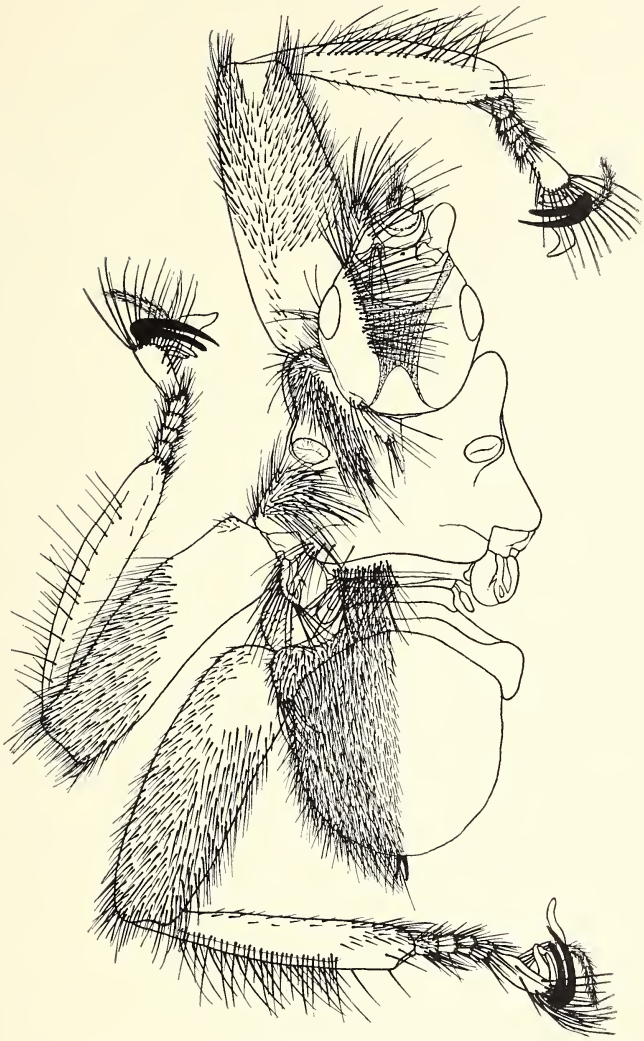

Fig. 36. *Myiophthiria* (*Brachypteromyia*) *neotropica* J. Bequaert, ♂ holotype, Galipan, on *Aëronautes m. montivagus*. × about 10.

covered with many long bristles; arista of 3rd segment protruding beneath appendage of 2nd, much flattened, elongate racket-shaped. Head beneath, on latero-anterior areas (corresponding to the parafacialia and facialia) with many long bristles (vibrissae) in several rows, crowded along inner (buccal) margin; latero-posterior areas (postgenae) with 2 long setae on each side. Thorax wider before wings than long from tip of humeral callosity to base of abdomen; anterior margin of prescutum deeply, but broadly and evenly curved inward. Humeral callosity wide throughout, lobular, broadly rounded at tip, separated by a shallow inward curve from the more prominent preälar angle. Pro-mesonotal suture distinct, but in dorsal view visible only medially behind occipital margin; scuto-scutellar suture deep, straight; a distinct suture between notopleuron and epipleurites at base of wing; posthumeral suture marked at sides only, behind and close to spiracles, curved backward; transverse mesonotal suture placed far back and weakly marked only over lateral third; notal suture weakly indicated over anterior half of mesonotum; other dorsal sutures obsolete, the humeral callosities, notopleura, and anepisterna fused with prescutum. Scutellum very wide and short, with nearly parallel anterior and posterior margins, with a superficial, transverse, preäpical, linear groove. Metapleuron with a short, conical, blunt pleurotergal protuberance, covered by the wing. Prothoracic spiracle very large, entirely dorsal; metathoracic spiracle large. Chaetotaxy of thorax consisting of patches of long bristles, difficult to homologize with the muscoid pattern: a dense oblique patch on the humeral callosity extends to beyond spiracle, where it ends far from middle of mesoscutum, but stretches across it some distance from anterior margin; a dense patch over most of anepisternum; 6 or 7 long bristles (postalars) close to wing, on each side behind the transverse mesonotal suture, and more medially a row of 3 bristles (prescutellars); many long scutellars in 2 or 3 irregular rows on disk and a row of similar bristles on hind slope of scutellum. Sternum (Fig. 36): basisternum of prothorax divided by a deep, triangular notch into two broad lobes, bluntly rounded at apex, bare; mesosternum broader than long, with a longitudinal furca, bare except for a narrow patch of setae on each side before mid coxa; basisternum of metathorax with a longitudinal furca ending posteriorly in a deep pit, bearing only a narrow cross-patch of setae (broadly interrupted medially) near hind margin; furcasternum of metathorax deeply depressed medially, saddle-like, bare. Legs very long and stout; fore and mid pairs about alike, hind pair slightly

longer. Coxae short, with many short setae and several long bristles. Trochanters short, with a few short setae near apex. Femora fairly evenly swollen throughout, mostly bare ventrally, dorsally with many stiff hairs and bristles leaving bare a broad basal area (more extensive on mid and less so on hind pair). Tibiae flattened, dorsally with a superficial longitudinal groove bearing a row of erect bristles; a similar row of bristles near outer lower edge; a few short setae elsewhere; apices ventrally with a patch of strong bristles, but without spurs proper. Tarsi: segments 1 to 4 with many short, stiff bristles; distitarsus longer and broader, with very long setae, mostly in a transverse dorsal row at apex. Claws as usual in the genus. Wing (Fig. 35*G*) very short, pad-like, about twice as long as scutellum, scarcely longer than wide; venation decidedly more reduced than in *B. fimbriata,* crowded in anterior or outer half, of 2 or 3 thick longitudinal veins; costa very thick, with many long bristles on basal $\frac{2}{3}$ and at apex; other veins bare; membrane bare. Halteres well developed, on long stalks. Abdomen (in dried, contracted condition) short, densely hairy both above and below. Dorsally, a short, moderately broad basal tergite, covered with minute setae; behind this a much wider sclerotized tergite, with incurved hind margin and broad side lobes, covered with short, stiff setae, with a row of long bristles at hind margin and a patch of even stronger ones at tips of side lobes. A short, setulose basal sternite. No other sclerotized tergal or sternal plates on the membranous abdomen. Penis valves straight, slender, rod-like, very gradually widened toward base, blunt at apex. Total length, in dried condition, 9 mm.; from tips of apical arms of frons to hind margin of scutellum, 5.6 mm.; of wing, 0.8 mm. Beebe (1949) noted that the abdomen was "bright sage-green" in life. *Female* unknown.

Ornithoctona Speiser, 1902

Ornithoctona Speiser, 1902, Termész. Füzetek, **25**, p. 328 (type by original designation: *Ornithomyia erythrocephala* Leach, 1817).
Ornithoctena Patton and Cragg, 1913, Textbook Medical Entomology, p. 407 (error for *Ornithoctona*).

Generic Characters. Fully-winged parasites of birds, not metallic-greenish, often with a dull-green pigment in the haemolymph visible in life through the integument. Head transversely elliptical, deeply inserted between the humeral callosities; occipital margin covering anterior margin of prescutum. Ocelli well developed. Eyes large, occupying most of sides of head, with many

minute ommatidia. Postvertex and frons far apart; soft mediovertex much longer than either. Occipital margin straight or slightly arched. Lunula with a median fovea (sometimes reaching ptilinal suture), superficially divided from the very narrow interantennal area; the latter long, ending in a narrow and shallow, concave emargination, the apical arms short, narrow, slightly diverging (covered by inner margins of antennal appendages). Antennae very wide and long: 1st segment usually with 1 or 2 short setae, rarely bare, either superficially divided from or almost completely fused with lunula, the suture present at least at extreme inner and outer sides as short depressions, that at the inner (median) side often forming a deep fovea (one on each side of the narrow interantennal area); 2nd segment consisting mostly of the long, broad, leaf-like appendage, varying in shape with the species and to some extent also intraspecifically, its upper surface flat, with an oblique, blunt ridge and more or less raised or thickened rims; both appendages parallel, directed forward, covering apical arms of frons and palpi; arista ending in a racket-shaped, translucent plate. Palpi very short, broad. Thorax (Figs. 8*A*, 9*A* and 10*A*) depressed, much wider than long. Pronotum short, not visible from above. Humeral callosities large, produced forward as prominent, obtusely pointed lobes; posthumeral suture deep at side, curved forward far from median notal suture, not reaching anterior margin; prothoracic spiracle large, near outer hind margin of callosity. Anterior margin of prescutum nearly straight, curving gradually at the side into the inner margin of humeral callosity; transverse mesonotal suture deep, slightly wavy, broadly interrupted medially, at about hind third of mesonotum; anterior ridge of parascutellum fused with mesoscutum; median notal suture very fine, complete from near anterior margin to scutellum; notopleuron well set off throughout from prescutum, wedge-shaped, narrow anteriorly, much broader posteriorly. Dorsal portion of anepisternum broad, lathe-shaped, parallel-sided, with broadly rounded, slightly projecting outer hind edge. Scutellum broad, short, transversely elliptical; hind margin slightly and evenly convex; disk smooth, flat or convex, with or without longitudinal depression or groove; scuto-scutellar suture mostly deep. Pleurotergite of metathorax low, scarcely swollen, without process. Basisternum of prothorax separated from mesosternum by a complete suture, consisting almost entirely of two long, bluntly conical, intercoxal lobes, produced forward and separated by a deep, triangular emargination. Mesosternum divided into basisternum and

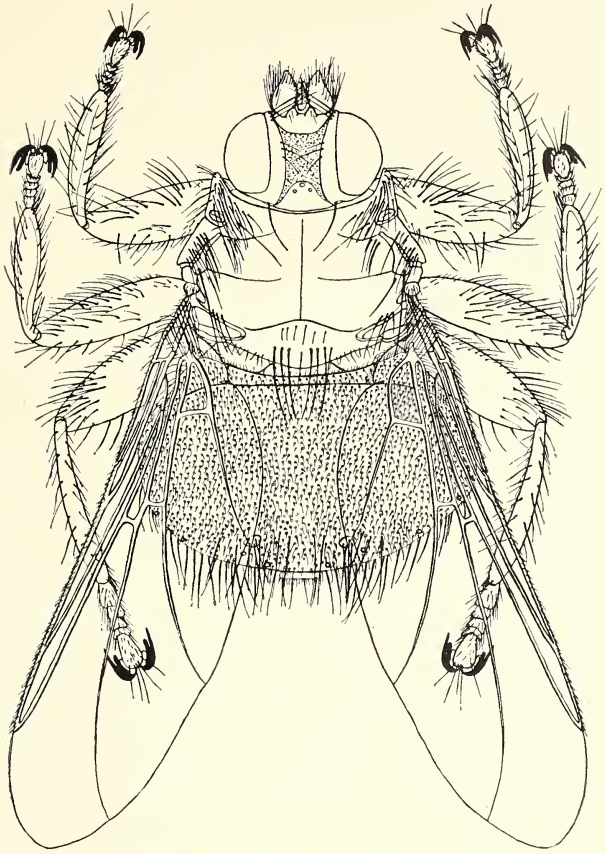

Fig. 37. *Ornithoctona erythrocephala* (Leach), ♀, St. Vincent, on *Amazona guildingii*. × about 10.

furcasternum by a complete, broadly V-shaped suture (with blunt forward angle). Metasternum undivided, produced forward as a sharp triangle; no metasternal spur near hind coxa. Median longitudinal sternal suture very fine, running over entire mesosternum. Metathoracic spiracle placed below and close to pleurotergite, a short distance from hind coxa. Legs robust; femora usually swollen; tibiae much flattened; hind basitarsus in most species with a transverse basal comb of short, often spine-like setae beneath; tips of tibiae normal in most species, in the Oriental *O. plicata* (v. Olfers) that of fore leg produced as a plate in ♀ and with a tuft of setae in ♂; tibial spurs usually not differentiated

from apical bristles. Claw proper divided to near base in two teeth, the terminal one very long, slender and sharp, the inner one shorter, broader and blunter; in addition a shorter, broad, flattened, bluntly pointed, basal "heel" (claw seemingly tridentate). Wing large, with the complete venation of *Ornithomyia,* including 3 cross-veins; axillary cell rarely with a rudimentary extra longitudinal vein; anterior basal cross-vein at or a short distance basad of anterior cross-vein; 2nd basal at least twice as long as anal cell, not or slightly shorter than 1st basal; 1st, 2nd and 3rd longitudinal veins ending in costa at sharp angles; subcosta complete, ending in costa a little basad of 1st longitudinal; small bullae in anterior basal cross-vein and in basal elbow of 4th longitudinal; posterior basal cross-vein very slanting, upper outer angle of anal cell acute; costa and basicosta setulose; all other veins bare; membrane either completely bare or in some species with a few patches of microtrichia apically; alula very large; calypteres (Fig. 13*D*) distinct, though reduced in size, the lower one slightly larger than the upper. Abdomen dorsally with the usual fused basal pleurotergites and a pair of preäpical sclerites, which are larger in ♂ than in ♀; remainder of dorsum membranous, without striated median area; other median sclerites small or absent in ♀, always present and large in ♂. Seven pairs of abdominal spiracles in membranous sides of abdomen, the 2nd ventral, the 3rd to 7th dorso-lateral, the 6th close to, but not within, the preäpical sclerites (Figs. 44*C–D*). Body more setose than usual on antennae, sides of thorax and abdomen, but middle of notum and sternum nearly bare; orbital bristles few, in one row; usually 1 vertical bristle on each side, close to postvertex. Thoracic bristles as shown in Figs. 8*A,* 9*A* and 10*A:* many, very stiff humerals; small groups of presuturals and postalars; usually 2 notopleurals; 1 supraälar; 1 posterior dorso-central; a few spaced scutellars in one preäpical row; hind margin of scutellum with a loose fringe of soft setae; metathoracic pleurotergite bare; a small group of hypopleurals above hind coxa. Abdomen fairly uniformly covered with short setae on small knobs and with many longer bristles behind, both dorsally and ventrally. Abdomen of ♂ ventrally with a median, preäpical pair of more or less sclerotized plates; apicad of these, terminalia (Figs. 38*D–E*) greatly simplified, much as in *Ornithomyia:* gonocoxites (paralobes) reduced to a pair of very small, narrow, conical lobes (with 1 or 2 long setae), one at inner hind corner of each of the lateral areas which extend behind the horseshoe-shaped sclerite; a pair of very heavy, bluntly pointed penis valves (parameres), in side view

with a broad, triangular base; penis rod-like, heavy, moderately pointed.

The genus contains some of the largest hippoboscids known and the largest New World species (*Ornithoctona nitens*).

Ornithomyia nitens Bigot, the type of *Ornithopertha* Speiser, agrees with the other *Ornithoctona* in essential characters; but the antennal appendage is unusually long, parallel-sided and very broadly rounded-truncate at apex, merely exaggerating the characteristic feature of *Ornithoctona*. Moreover, the antennal appendage of *O. orizabae* is somewhat transitional between that of *nitens* and of *erythrocephala*. *Ornithopertha* is here given subgeneric status, but it might well be sunk as a synonym.

The antennal appendage, or enlarged apical extension of the 2nd segment, one of the exclusive features of all Hippoboscidae (Part I, pp. 25–27), is no doubt a refined adaptation to parasitic life in plumage. It allows for swift motion among the feathers, protects the sensoria of the 3rd segment and arista against mechanical injury and dirt, and guides the fly by means of its tactile bristles in the dark recesses of the plumage. This structure reaches its extreme development in *Ornithoctona* and *Stilbometopa:* it becomes very long and wide, is flattened or partly concave, leaf-like, and has a pointed or bluntly rounded tip. Its overdevelopment or hypertely culminates in the weird, shovel-shaped antenna of *O.* (*Ornithopertha*) *nitens*. It is questionable whether such extreme development adds materially to the usefulness. As often happens for hypertelic structures, the shape of the leaf-like appendage is subject to much intraspecific variation, which complicates the definition of species in *Ornithoctona*.

Ornithoctona occurs in both the Old and the New World. In the Old World it is restricted to the tropics, being unknown in the Palearctic Region, but common in Africa, southern Asia, Indo-Malaya and Queensland, and accidental only in the temperate parts of Australia. In the New World it is also essentially tropical, but the two common species spread, at least during the summer months, to the eastern half of temperate North America as far as southern Canada (northmost record in 56° N., for *O. erythrocephala*). I recognize only 9 valid species, 5 of which are endemic in the New World.

The puparium, described only for *O. fusciventris,* agrees in general shape, structure of the respiratory apparatus and surface sculpture with that of *Ornithomyia*.

Key to American Species of *Ornithoctona*

1. Antennal appendage about $\frac{2}{3}$ of height of head, over 3 times as long as its greatest width, spoon-shaped, with nearly parallel sides and broadly rounded tip, the upper surface deeply and broadly grooved basally. Interocular face at postvertex slightly wider than an eye in ♀, distinctly narrowed below. Upper orbit shorter than width of inner orbit at ptilinal suture. Abdomen of ♀ without median dorsal sclerites. Apical portion of wing (beyond tip of costa) with small patches of microtrichia. Wing 11 to 12.5 mm. long ..... *O. nitens*

   Antennal appendage at most 3 times as long as its greatest width, less than $\frac{2}{3}$ of height of head, the sides not parallel throughout, with narrowed, either pointed or blunt tip..... 2

2. Upper orbit shorter than width of inner orbit at ptilinal suture. Anterior ocellus below a line drawn along upper eye margins; posterior ocelli on or close to this line 3

   Upper orbit fully as long as width of inner orbit at ptilinal suture. Anterior ocellus placed on or slightly above a line drawn along upper eye margins; posterior ocelli well above this line. Upper surface of antennal appendage grooved lengthwise, except at tip. Abdomen in both sexes with 3 median dorsal sclerites. Apical third of wing partly covered with microtrichia 4

3. Antennal appendage nearly twice as long as its greatest width or shorter, with at least the inner margin convexly curved in basal half, more or less pointed at tip, the edges of the apical portion somewhat upturned. Interocular face less than twice as long as wide, at its narrowest wider than an eye in both sexes. Median tergal sclerites of abdomen present and large in ♂, absent in ♀. Wing entirely bare. Wing 7 to 8 mm. long in ♂, 8.5 to 10 mm. in ♀ ..... *O. erythrocephala*

   Antennal appendage nearly three times as long as its greatest width, almost parallel-sided basally, gradually narrowed and triangular apically, with blunt tip, the basal upper surface superficially grooved. Interocular face more than twice as long as wide, at its narrowest distinctly narrower than an eye in ♂. Apical portion of wing partly covered with microtrichia. Wing 10 mm. long. (♀ unknown) ..... *O. orizabae*

4. Larger, the wing 8.5 to 9.5 mm. long. Antennal appendage fully two and one-half times as long as its greatest width; the pointed tip long and narrow seen from above, compressed from the sides. Scutellum with 3 or 4 pairs of strong preäpical setae ..... *O. oxycera*

   Smaller, the wing 5.5 to 7 mm. long. Antennal appendage nearly twice as long as its greatest width, gradually widened basally, the outer and inner margins about equally curved; the short tip either rounded or bluntly pointed, not compressed from the sides. Scutellum with 2 or 3 pairs of rather weak preäpical setae ..... *O. fusciventris*

Subgenus *Ornithoctona,* proper

Antennal appendage 2 to 3 times as long as its greatest width, more or less tapering apically; outer and inner margins usually curved outwardly, seldom nearly parallel basally; tip distinctly narrowed, either sharply pointed or bluntly rounded.

Ornithoctona erythrocephala (Leach)

Figs. 8*A*, 9*A*, 10*A*, 13*D*, 37, and 38*A–K*

Ornithomyia erythrocephala Leach, 1817, Gen. Spec. Eproboscideous Ins., p. 13; Pl. 27, figs. 4–6 [1818, Mem. Werner. Nat. Hist. Soc., Edinburgh, **2**, pt. 2, p. 559; Pl. 27, figs. 4–6] (no sex; no host. Brazil. Type ♀ at Brit. Mus.). Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 610 (copy of description). Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1143 (Jamaica: on *Corvus jamaicensis, Columba ''rufina''* [*C. leucocephala*], *''Tityra leuconotus''* [*Platypsaris niger*], *''Geotrygon montana''* [*Oreopeleia m. montana*], *Geotrygon ''sylvatica''* [*G. versicolor*], *''Turtur leucopterus''* [*Zenaida a. asiatica*], *''Ephialtes grammicus''* [*Pseudoscops grammicus*], *Saurothera v. vetula, ''Herodias virescens''* [*Butorides virescens maculatus*], *Falco c. columbarius, ''Peristera jamaicensis''* [*Leptotila j. jamaicensis*], *''Strix pratincola''* [*Tyto alba furcata*], and *''Zenaida amabilis''* [*Z. aurita zenaida*]. Brazil. Peru. Venezuela). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213 (Cuba: Canada: Quebec). van der Wulp, 1883, Tijdschr. v. Entom., **26**, p. 59 (Guadeloupe). Gundlach, 1887, An. Soc. Españ. Hist. Nat., **16**, p. 199. Johnson, 1894, Proc. Ac. Nat. Sci., Philadelphia, p. 281. Williston, 1896, Trans. Ent. Soc. London, p. 439 (St. Vincent). Coquillett, 1900, Proc. U. S. Nat. Mus., **22**, p. 269 (Puerto Rico: Adjuntas, on *Falco sparverius loquaculus;* Culebra I.).

Ornithomyia (*Ornithoctona*) *erythrocephala* Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 263 (type).

Ornithoctona erythrocephala Speiser, 1902, Termész. Füzetek, **25**, p. 329; 1904, Zeitschr. Syst. Hym. Dipt., **4**, p. 82 (synonymizes type of *gemina* Thomson); 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41**, p. 345. Washburn, 1905, Univ. Minnesota, Agric. Expt. Sta. Bull. **93**, p. 163 (Minnesota: on *Buteo p. platypterus*). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654 (Guadeloupe). Speiser, 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, pp. 303 and 304. Newstead, 1909, Ann. Trop.

Med. Paras., 3, p. 467 (Jamaica: Worthy Park, on *''Conurus nanus''* [*Aratinga nana*]; Friendship, Sa. Cruz Valley, St. Elizabeth, on *''Falco peregrinus nigriceps''* [*F. peregrinus anatum*]); 1910, Bull. Dept. Agric., Jamaica, (N. S.), 1, pt. 3, p. 175 (same records). Johnson, 1913, Bull. Amer. Mus. Nat. Hist., 32, p. 90 (Florida: St. Augustine). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, 7, pp. 186 and 188; Pl. 28, fig. 8 (Brazil: São Paulo; Florianopolis, State Sa. Catharina, supposedly on *''Catharista atrata''* [*Coragyps atratus foetens*]). Brèthes, 1920, An. Soc. Cientif. Argentina, 89, p. 33 (Peru: Lima). Johnson, 1922, Psyche, 29, p. 84 (Quebec: Metis, on *Falco c. columbarius;* Montreal, on *Botaurus lentiginosus.* Cuba: on *''Buteo borealis''* [*B. jamaicensis umbrinus*] and *B. platypterus cubanensis;* Holguin, on *''Geotrygon montana''* [*Oreopeleia m. montana*]. Puerto Rico, on *Falco sparverius loquaculus*[35]). Bau, 1922, Centralbl. Bakt. Parasit., Abt. 2, 57, p. 276. Wolcott, 1924, Jl. Agric. Univ. Puerto Rico, 7, (for 1923), pt. 1, p. 234 (Puerto Rico: Aibonito and Cabo Rojo, on ''sparrow hawk'' [*Falco sparverius loquaculus*]; Caguas, on ''Porto Rico dove'' [*Columbigallina passerina portoricensis*]). Johnson, 1925, Occ. Papers Boston Soc. Nat. Hist., 7, p. 293 (Maine); 1925, Bull. Northeastern Bird-Banding Assoc., 1, pt. 4, p. 52 (Canadian records repeated). Bau, 1929, Zoolog. Anzeiger, 85, p. 11 (Mexico. Cuba. Venezuela. Brazil: Rio Grande do Sul. One of these specimens on *''Gymnoglaux* sp.''). Falcoz, 1930, Encyclop. Entom., Ser. B, Diptera, 5, (for 1929), p. 38 (Costa Rica. Mexico. Peru: Lima. Colombia, on domestic pigeon. Chile: Valparaiso. Brazil: Guaratuba, State Paraná; Rio Grande do Sul. Argentina: Chaco de Santiago, at the Río Salado. ♀ ♂. Synonymizes *gemina* Thomson, *bellardiana* Rondani, *haitiensis* Bigot and *robusta* van der Wulp). J. Bequaert, 1933, Rev. Chilena Hist. Nat., 37, p. 163. Wolcott, 1936, Jl. Agric. Univ. Puerto Rico, 20, pt. 1, p. 392 (Puerto Rico: Lajas; Las Marías, on ''West Indian red-tailed hawk'' [*Buteo j. jamaicensis*]). Spencer, 1938, Proc. Ent. Soc. British Columbia, 34, p. 44 (British Columbia: Osoyoos, on *Falco peregrinus anatum*). Strickland, 1938, Canad. Jl. Res., Sect. D, 16, p. 219 (Alberta: on ''burrowing hawk'' [for broad-winged hawk, *Buteo p. platypterus*]). Brimley, 1938, Insects North Carolina, p. 389 (North Carolina: Raleigh, on ''broad-winged hawk'' [*Buteo p. platypterus*]; Charlotte, on ''Cooper's hawk'' [*Accipiter cooperii*]). J. Bequaert, 1939, Science, 89, p. 268; 1940, Mem. Soc. Cubana Hist. Nat., 14, No. 4, p. 315; 1940, Rev. Acad. Colombiana Ciene. Ex. Fis. Nat., 3, No. 12, p. 415. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, 25, pt. 1, p. 121 (Puerto Rico: on *''Gymnasio nudipes''* [*Otus n. nudipes*]; Mayaguez, on *''Buteo borealis''* [*Buteo j. jamaicensis*]). J. Bequaert, 1942, Bol. Entom. Venezolana, 1, pt. 4, p. 80; 1943, Jl. of Parasitology, 29, p. 135. Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, 28, (for 1944), pts. 3–4, p. 154 (St. Croix: on *Buteo j. jamaicensis*). MacArthur, 1948, Bull. Publ. Mus. Milwaukee, 8, pt. 4, pp. 403 and 405, figs. 240–241 (Illinois: without precise locality, on *Falco s. sparverius;* Niles, on *Buteo p. platypterus;* Calumet Lake, on *Accipiter cooperii;* Havana. Minnesota: without precise locality, on *Buteo p. platypterus;* Ortonville, Big Stone Co., on *Buteo p. platypterus.* Wisconsin: without precise locality). Thompson, 1949, Ent. Mo. Mag., 85, p. 248 (Jamaica: Spring Gardens, Portland, on *Buteo j. jamaicensis;* Mt. James, St. Andrew, on *Buteo j. jamaicensis;* Cross Roads, St. Andrew, on *Buteo j. jamaicensis;* Kew

[35] The record from Dominica, on *Nyctanassa violacea,* is erroneous, as the specimen was collected in Jamaica.

Park, Westmoreland, on *Pseudoscops grammicus;* Hermitage, St. Andrew, on *Oreopeleia m. montana;* Bath, St. Thomas, on *Chordeiles minor gundlachii*). Herms, 1950, Medical Entomology, 4th Ed., p. 414. Wolcott, 1951, Jl. Agric. Univ. Puerto Rico, **32**, (for 1948), pt. 3, p. 530. J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, pt. 1, (for 1950), p. 8. Schuurmans Stekhoven, 1952, Beiträge zur Fauna Perus, 3, Wissenschaftl. Bearbeit., pp. 94 and 101.

Ornithomyia cryptocephala Stahl, 1882, Fauna Puerto Rico, **2**, p. 206 (Puerto Rico. Error for *erythrocephala*).

Ornithoctena erythrocephalia Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull., 4, pts. 1–2, p. 89 (error for *erythrocephala*).

Ornithomyia nebulosa Say, 1823, Jl. Ac. Nat. Sci. Philadelphia, **3**, p. 102 (no sex. United States, without precise locality, on *Strix nebulosa.* Type lost). Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 610 (locality surmised to be Pennsylvania). Say, 1837, Oeuvres Entomologiques, edit. by Gory, p. 103. Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1143. Osten Sacken, 1858, Cat. Dipt. North America, p. 86. Say, 1859, Complete Writings, edit. by LeConte, **2**, p. 87. Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 213. Brodie and White, 1883, Check List Ins. Dom. Canada, p. 57. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654.

Ornithomya nebulosa Howard, 1883, South Carolina, Resources and Population, p. 275.

Ornithoctona (?) *nebulosa* Speiser, 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303.

Ornithoctona nebulosa Peters, 1936, Bird-Banding, **7**, p. 14 (Maryland: on *Falco c. columbarius*).

Ornithomyia gemina Thomson, 1869, Svensk. Freg. Eugenies Resa, Vet. Iakttag., **2**, Zool., pt. 1, Insekter, Häft 12, (1868), p. 611 (♀; no host. Peru: Callao. Type at Stockholm Mus.).

Ornithomyia bellardiana Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 157 (no sex; no host. Mexico. Supposed ♀ type at Genoa Mus., now labelled "*Ornithomyia pyrrhocephala*").

Ornithoctona bellardiana Speiser, 1902, Termész. Füzetek, **25**, p. 329; 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41**, pp. 344 (type) and 345. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654. Speiser, 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Bau, 1922, Centralbl. Bakt. Parasit., Abt. 2, **57**, p. 276; 1929, Zoolog. Anzeiger, **85**, p. 11 ("San Francisco, Cuba").

Ornithomyia pyrrhocephala "Rondani" Speiser, 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41**, p. 344 (no sex; no host. Mexico. On the label of the presumed type of *O. bellardiana*, which is not now at the Genoa Mus. under that name; with new description).

Ornithomyia haïtiensis Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 242 (no sex; no host. Haiti. Type from Bigot Coll., now in J.E. Collin Coll.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 192 (copy of description).

Ornithoctona haitiensis Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 168 (type; redescribed); 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41**, p. 345. Bau, 1922, Centralbl. Bakt. Parasit., Abt. 2, **57**, pp. 274 and 276 (Cuba: on "Kampfhahn"; [probably a domestic "fighting cock"]).

Ornithoctona haitensis Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654 (also misspelled *hatiensis* on same page). Speiser, 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Ornithomyia robusta van der Wulp, 1903, Biol. Centr.-Amer., Diptera, **2**, p. 431; Pl. 13, figs. 5 and 5*a-c* (♀ ♂ according to the author; but all types ♀, according to Austen, 1903; no host. Mexico: Jalapa. Guatemala: Zapote. Costa Rica: Caché, ♀ now labelled as type. Panama: Volcan de

Chiriqui. Cotypes ♀ at Brit.Mus.). Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 262 (types all ♀; synonymized with *erythrocephala* Leach).

Ornithoctona robusta J. Bequaert, 1938, Carnegie Publ. No. **499**, p. 227.

Ornithomyia buteonis Swenk, 1916, Jl. New York Ent. Soc., **24**, p. 133 (no sex. Nebraska: Neligh, holotype, on "broad-winged hawk" [*Buteo p. platypterus*]. Costa Rica: Guápiles, paratype, without host. Types, both ♀, at Dept. Entom., Univ.Nebraska, Lincoln). Muma, 1952, Bull. Univ. Nebraska State Mus., **3**, pt. 3, p. 14 (holotype only listed).

Ornithomyia costaricensis Swenk, 1916, Jl. New York Ent. Soc., **24**, p. 134 (no sex; no host. Costa Rica: Juan Viñas. Type ♀ at Dept. Entom., Univ. Nebraska, Lincoln). Muma, 1952, Bull. Univ. Nebraska State Mus., **3**, pt. 3, p. 14 (type).

Ornithoctona albiventris Bau, 1922, Centralbl. Bakt. Parasit., Abt. 2, **57**, pp. 274 and 276 (♀. Cuba: Estación Meyer, Prov. Sa. Clara, on "Grosse weisse Nachteule," surmised by Bau to have been "*Strix flammea* var. *furcata* Ridg." [*Tyto alba furcata*]. Type at Berlin Mus.).

Distribution and Specimens Examined. Dominion of Canada. Alberta (recorded by Strickland, 1938): Belvedere, on *Buteo p. platypterus* (C.G. Harrold). — British Columbia (recorded by Spencer, 1938): Okanagan Falls, on *Falco peregrinus anatum* (K. Racey; R.A. Cumming and G.J. Spencer). — Manitoba: Vivian, on *Buteo p. platypterus* (A.H. Short); Winnipeg, on *Buteo p. platypterus* (J.O. Soper). — Nova Scotia: Cape North, on chicken hawk (T. McElvoy). — Ontario: Macdiarmid, Lake Nipigon, on *Buteo p. platypterus* (N.K. Bigelow); 20 miles N.E. of Nipigon, on *Buteo p. platypterus* (A.E. Allin); Spring Bay, Manatoulin, on *Buteo p. platypterus* (J.L. Baillie); Point Pelée, on hawk (A.W. Andrews); Schreiber, on *Buteo jamaicensis borealis* (Peterson and Muir); Fort Severn, 56° N. (C.E. Hope). — Quebec (recorded by Osten Sacken, 1878; Johnson, 1922): Little Metis, on *Falco c. columbarius* (L.M. Terrill); Montreal, on *Botaurus lentiginosus* (J. Ouellet); Maisonneuve, on *Pandion haliaetus carolinensis* (Frère Roger Albert); Kamouraska (au Moulin), Kamouraska Co., on *Pandion haliaetus carolinensis* (W. LaBrie); Val d'Espoir, on *Falco c. columbarius*, June (Frère Adrien Robert).

United States. Connecticut: West Haven, New Haven Co., on *Buteo p. platypterus* (R.C. Morrill). — Florida (recorded by Johnson, 1913): St. Augustine, St. Johns Co. (C.W. Johnson). — Georgia: Eastanollee, Stephans Co. (D.M. Moore); Stone Mountain, De Kalb Co., on *Falco s. sparverius* (W.E. Bowers); [Macon, Bibb Co., on *Accipiter striatus velox;* Atlanta, Fulton Co. — According to P.W. Fattig, *in litt.;* not seen]. — Illinois (recorded by MacArthur, 1948): Chicago, Oct. 13, on *Falco s. sparverius* (J. Schreiber); Niles, Cook Co., on *Buteo p. platypterus*, Apr. 19 (A.B. Wolcott); Calumet Lake near Chicago, on *Accipiter cooperii*, Apr.

20 (J. Friesser); Havana, Mason Co., Sept. 16 (Hempel). — Iowa: Ames. — Kansas: Douglas Co. (F.H. Snow); Baldwin City, Douglas Co., June 9 (A.B. Cramlingon); Leavenworth, Leavenworth Co., on *Accipiter striatus velox* (M.J. Brumwell). — Maine (recorded by Johnson, 1925): Orono, Penobscot Co., on *Falco c. columbarius,* May 20 (C.P. Alexander); Lincoln, Penobscot Co., on *Accipiter striatus velox* (A.E. Brower). — Maryland (recorded by Peters, 1936): Patuxent Refuge, Bowie, Prince Georges Co., on *Falco c. columbarius,* Apr. 10; Laurel, Prince Georges Co., on *Buteo p. platypterus,* May 11, *Buteo jamaicensis borealis,* March, and *Falco c. columbarius,* May 4 (E.B. Marshall). — Massachusetts: Hyde Park, Suffolk Co., on *Falco c. columbarius,* May 6; Concord, Middlesex Co., on *Falco c. columbarius* (B.P. Mann); Berlin, Worcester Co. — Michigan: Whitefish Point, Chippewa Co., on *Accipiter striatus velox,* May 22 (J.S. Ligon). — Minnesota (recorded by Washburn, 1905; MacArthur, 1948): without precise locality, on *Buteo p. platypterus,* May 1 and 14; Ortonville, Big Stone Co., on *Buteo p. platypterus.* — Mississippi: Rosedale, Bolivar Co., on *Buteo p. platypterus* (M.D. Vaiden); A. and M. College, Oktibbeha Co. — Missouri: Columbia, Boone Co., on hawk (L. Jeffrey). — Montana: Kendall, Fergus Co., May 25 (W.L. Knull). — Nebraska (recorded by Swenk, 1916, as *O. buteonis*): Neligh, Antelope Co., on *Buteo p. platypterus,* Apr. 26 (holotype of *O. buteonis.* — M. Cary). — New Hampshire: Sandwich, Carroll Co., on *Buteo p. platypterus* (R.G. Carpenter, Jr.). — New Jersey: Stockholm, Sussex Co., on *Accipiter striatus velox* (J. Vonlengerke). — New York: without precise locality, on *Haliaeëtus l. leucocephalus* (J. Akhurst); Orient, Long Island, on *Accipiter striatus velox,* May 16, and *Accipiter cooperii,* Oct. 6 (Roy Latham); Yonkers, Westchester Co., on *Buteo p. platypterus* (I.D. Dobroscky); Stuyvesant Falls, Columbia Co., Sept. 12, on *Buteo jamaicensis borealis;* Bainbridge, Chenango Co., March 18; West Point, Orange Co., on *Buteo p. platypterus,* Apr. 18, Oct. 10, Nov. 16 (W. Robinson); Westport, Essex Co., on *Buteo p. platypterus* (E.J. Gerberg); Albany, on *Phasianus colchicus,* Oct. 17 (A. Paladin). — North Carolina (recorded by Brimley, 1938): Raleigh, Wake Co., on *Buteo p. platypterus* (Mrs. R.C. Simpson); Charlotte, Mecklenburg Co., on *Accipiter cooperii* (W. Smith); Washington, Beaufort Co., on (?wild) pigeon (H.C. Bragaw); Swan I., Currituck Sound, Currituck Co., on *Branta c. canadensis* (C.M.B. Cadwallader).—North Dakota: Turtle Mts., 6 miles N. W. of St. John, Rolette Co., on *Buteo p. platypterus* (A. Wetmore). — Ohio: South Bass I., Put-in Bay,

Ottawa Co., on *Phasianus colchicus* (F.J. Ligas); Greenville, Darke Co., on *Megaceryle a. alcyon* (R. Rausch); Ottawa Co., May 22, on *Accipiter cooperii* (E.S. Thomas); Franklin Co., on *Sphyrapicus v. varius* (C.F. Walker). — Pennsylvania: without precise locality, on *Accipiter striatus velox* (L. Luttringer); Berks Co., on *Buteo p. platypterus* (O.G. Harrold); Coburn, Centre Co., on *Accipiter striatus velox* (H.K. Wingard); Drehersville, Schuylkill Co., on *Accipiter gentilis atricapillus;* Delaware Co., on *Haliaeëtus l. leucocephalus* (C.W. Johnson); Meckville, Berks Co., on *Buteo p. platypterus* (L.S. Dillon); Reading, Berks Co., on *Falco c. columbarius* (L.S. Dillon). — West Virginia: Fort Spring, Greenbrier Co. (Mrs. W.L. Mitchell). — Wisconsin (recorded by MacArthur, 1948): Dane Co. (C.A. Herrick).

Mexico (recorded by Rondami, 1878, as *O. bellardiana;* van der Wulp, 1903, as *O. robusta;* Speiser, 1904, as *O. pyrrhocephala;* Bau, 1929; Falcoz, 1930); without precise locality (Ac.N.S.Phila.), and on *Dactylortyx thoracicus* and *Penelopina nigra* (Esc.N.C. Biol.); Santa Rosa, Comitán, State of Chiapas, on *Cyanolyca pulchra mitrata, Pharomachrus m. mocino,* and *Buteo* sp. (Esc.N.C. Biol.); Orizaba, State of Vera Cruz (A. Sallé); Jalapa, State of Vera Cruz (F.D. Godman. — Cotype ♀ of *robusta*).

Guatemala (recorded by van der Wulp, 1903, as *O. robusta*): Zapote (G.C. Champion. — Cotype of *robusta*).

Republic of Honduras: Subirana, on *Buteo magnirostris argutus* and *Zenaida a. asiatica,* Dept. Yoro, about 15° 6′ N., 87° 23′ W. (R. Stadelman).

Nicaragua: San Rafael del Norte, on *Herpetotheres c. cachinnans* and *Accipiter erythrocnemius chionogaster* (W.deW. Miller).

Costa Rica (recorded by van der Wulp, 1903, as *O. robusta;* Swenk, 1916, as *O. buteonis* and *O. costaricensis;* Falcoz, 1930): without precise locality (U.S.N.M.); southwestern section, on *Odontophorus* sp. (C.H. Lankester); Guápiles (paratype ♀ of *buteonis.* — J.C. Crawford); Juan Viñas (holotype ♀ of *costaricensis.* — L. Bruner); Caché (H. Rogers. — ♀ at Brit.Mus. now labelled type of *robusta*).

Panama (recorded by van der Wulp, 1903, as *O. robusta*): Volcán de Chiriqui, 9000 ft. (G.C. Champion. — ♀ cotype of *robusta*); Salta, Boquete, Chiriqui Prov., 5800 ft., on *Odontophorus guttatus veraguensis* (G.F. Ferris); Chorcha, Chiriqui Prov., on *Leptotila v. verreauxi* (G.B. Fairchild); Boquete, Chiriqui Prov., on *Leucopternis princeps* (L. Wheeler); El Volcán, Chiriqui Prov., on wild pigeon (C.B. Worth); San José, Pearl Is. (J.P.E. Morri-

son); Barriles, a few miles W. of El Volcán, Chiriqui Prov., on *Buteo jamaicensis costaricensis, Odontriorchis palliatus,* and *Myiobius barbatus atricaudus* (Mrs. M.E. McLellan Davidson).

Antilles. Bahamas: without precise locality (U.S.N.M.). — Cuba (recorded by Osten Sacken, 1878; Bau, 1922 and 1929, as *O. bellardiana, O. haitiensis* and *O. albiventris;* Johnson, 1922): without precise locality, on *Zenaida aurita zenaida* (J. Gundlach), *Oreopeleia m. montana* (Brit.Mus.), *Buteo platypterus cubanensis, Asio stygius sigaupa* (Hno. Robert), and *Accipiter gundlachi* (G. Aguayo); Guantanamo, Prov. Oriente, on *Oreopeleia chrysia;* Ensenada de Cochinos, Prov. Las Villas (Sa. Clara), on *Zenaida aurita zenaida* (T. Barbour and L.A. Shaw); Santiago de las Vegas, Prov. Habana, on *Glaucidium siju* (S.C. Bruner); Rangel, Prov. Pinar del Río (Brother Chrysozone); Guanajay, Prov. Pinar del Río (Palmer and Riley); Jiguani, Prov. Oriente (T. Barbour and L.A. Shaw); El Guama, Prov. Pinar del Río (Palmer and Riley); Tanamo, Prov. Oriente; Santiago de Cuba, Prov. Oriente, on chicken hawk; Las Animas, Sierra Rangel, Prov. Pinar del Río (Est.Exp.Agr.Cuba); Preston, Prov. Oriente, on *Zenaidura m. macroura* and *Holoquiscalis jamaicensis gundlachii* (J.L. Peters); San Diego de los Baños, Prov. Pinar del Río, on *Melanerpes s. superciliaris* (Burleigh and Duvall): Holguin, Prov. Oriente, on *Oreopeleia m. montana;* Artemisia, Prov. Pinar del Río, on *Accipiter gundlachi, Circus cyaneus hudsonius,* and *Oreopeleia chrysia* (I. Perez Vigueras). — Isle of Pines: Los Indios, on *Amazona l. leucocephala* (G. Link). — Jamaica (recorded by Walker, 1849; Newstead, 1909 and 1910; Thompson, 1949); without precise locality, on *Corvus jamaicensis, Columba leucocephala, Oreopeleia m. montana, Pseudoscops grammicus, Zenaida a. asiatica, Falco c. columbarius, Tyto alba furcata, Zenaida aurita zenaida, Butorides virescens maculatus,* and *Leptotila j. jamaicensis* (Walker's specimens at Brit.Mus.); Troy, on *Strix* sp. (W.R. Maxon); Mandeville (Elizabeth B. Bryant); Spanish Town, on *Columba leucocephala* (W.D. Neish); Claremont (L. Perkins); Bath, St. Thomas, on *Nyctanassa v. violacea*[36] (A.H. Verrill and O. Bangs) and *Chordeiles minor gundlachii* (Swainson); Quickstep, St. Elizabeth, on *Corvus jamaicensis* (C.B. Lewis); Falmouth, on *Buteo j. jamaicensis, Siphonorhis a. americanus, Columba leucocephala, Zenaida aurita zenaida* and *Z. a. asiatica* (H.B. Carroll); Spring Gardens,

[36] Johnson's (1922) erroneous record from Dominica was based on this specimen, now at M.C.Z.

Portland, on *Buteo j. jamaicensis* (G.B. Thompson); Mt. James, St. Andrew, on *Buteo j. jamaicensis* (G.B. Thompson); Hermitage, St. Andrew, 1800 ft., on *Oreopeleia m. montana* (H.B. Tordoff); Hartford near Priest River, on *Buteo j. jamaicensis* (W.R. Maxon); Kew Park, Westmoreland, 1100 ft., on *Pseudoscops grammicus* (H.B. Tordoff); Cross Roads, St. Andrew, on *Buteo j. jamaicensis* (G.B. Thompson). — Hispaniola (recorded by Bigot, 1885, as *O. haitiensis*): Constanza, Rep. Dominicana, on *Oreopeleia caniceps leucometopius* (W.L. Abbott); El Río, Rep. Dominicana, on *Buteo j. jamaicensis* and *Temnotrogon roseigaster* (W.L. Abbott); Farabacoa, Rep. Dominicana, on *Amazona ventralis* (A. Wetmore); Sanchez, Rep. Dominicana, on *Zenaida a. asiatica* and *Buteo j. jamaicensis* (A. Wetmore); Moca, Rep. Dominicana, on *Falco* sp. (Juan Lopez, through R. Frey); Puerto Plata, Rep. Dominicana (Hurst); Kenskoff near Petionville, 4500 ft., Haiti, on *Falco sparverius dominicensis* (W.A. Weber); Port-au-Prince, Haiti; Moline, Haiti, on *Falco c. columbarius;* Furcy, Haiti, on *Buteo j. jamaicensis* (G.E. Folk); Huiche, Haiti, on *Columba i. inornata* (A. Wetmore). — Mona Island: on *Columba i. inornata* (B.S. Bowdish). — Puerto Rico (recorded by Stahl, 1882; Coquillett, 1900; Johnson, 1922; Wolcott, 1924, 1936, 1941 and 1951); Adjuntas, on *Otus n. nudipes* (H.E. Anthony) and on *Falco sparverius loquaculus* (C.W. Richmond); Mayaguez, on *Zenaidura m. macroura* and *Buteo j. jamaicensis* (H.L. Dozier), and on *Saurothera vetula vieilloti* (B.S. Bowdish); Las Marías, on *Buteo j. jamaicensis* (S.T. Danforth); Aibonito, on *Falco sparverius loquaculus* (A. Wetmore); Caguas, on *Columbigallina passerina portoricensis;* Salinas, on *Leucophoyx t. thula* (A. Wetmore); Lajas, on *Buteo j. jamaicensis* (S.T. Danforth); Cabo Rojo, on *Falco sparverius loquaculus;* La Parquera, on *Asio flammeus portoricensis* (M. Agrait); El Yunque, on *Buteo platypterus cubanensis;* Rio Rondo, Mayaguez (A.R. Quiles). — St. Croix (recorded by Beatty, 1947): on *Buteo j. jamaicensis* (H.A. Beatty). — St. Thomas: (R. Sebastien), and in nests of *Zenaida a. aurita* and *Columba leucocephala* (G.A. Seaman).—Saba: top of Mt. Saba, on *Buteo platypterus rivieri* (S.T. Danforth); Hell Gate, on *Oreopeleia mystacea sabae* (S.T. Danforth). — St. Kitts: (S.T. Danforth). — Nevis: (James Bond). — Montserrat: on *Butorides virescens maculatus, Buteo platypterus rivieri, Falco sparverius caribaeorum,* and *Columba squamosa* (S.T. Danforth); on wild dove and sparrow hawk (Hubbard). — Guadeloupe (recorded by van der Wulp, 1883): Goyave, on *Melanerpes lherminieri* (S.T. Danforth). — Marie Galante: Trois Islets, on

Zenaida a. aurita (S.T. Danforth). — DOMINICA: Pointe Michelle (G.A. Ramage). — ST. VINCENT (recorded by Williston, 1896): on *Amazona guildingii* and *Oreopeleia m. montana;* Grand Bonhomme Mts., on *Buteo platypterus antillarum;* Three Rivers Estate, on *Buteogallus anthracinus cancrivorus* (A.R. Totton); windward side (H.H. Smith). — GRENADINES: Beguia I. — GRENADA: St. Andrews, on *Buteo platypterus antillarum* (R. Thaxter).

COLOMBIA (recorded by Falcoz, 1930): without precise locality, on *Buteo m. melanoleucus;* Fusugasugá, Dept. Cundinamarca (Hno. Apolinar-María); Quebrada Susumuco, Dept. Cundinamarca (Hno. Apolinar-María); Villavicencio, Int. del Meta (Hno. Apolinar-María); Valdivia, Dept. Antioquia, on *Chamaepetes g. goudotii* (M.A. Carriker, Jr.); Buenos Aires, Dept. Santander Norte, on *Penelope m. montagnii* and *Columba a. albilinea* (M.A. Carriker, Jr.); Volador, Dept. Bolivar, on *Accipiter b. bicolor, Elanoides forficatus yetapa, Eurypyga helias major, Oreopeleia violacea albiventer,* and *Odontophorus strophium* (M.A. Carriker, Jr.); Vista Nieve, Sa. Marta, Dept. Magdalena, on two *Oreopeleia linearis infusca* (M.A. Carriker, Jr.); Cincinnati, Sa. Marta, Dept. Magdalena, on two *Pionus sordidus saturatus,* one ♀ with 15 Mallophaga attached, and on *Piaya cayana mehleri* (M.A. Carriker, Jr.); Mt. San Lorenzo, Sa. Marta, Dept. Magdalena, on *Penelope argyrotis colombiana* (M.A. Carriker, Jr.); Siminchueva, Sa. Marta, Dept. Magdalena, on *Accipiter erythrocnemius salvini* (M.A. Carriker, Jr.); Mamancanaca, Sa. Marta, Dept. Magdalena, on *Columba a. albilinea* (M.A. Carriker, Jr.); Virolin, Dept. Santander Norte, on *Buteo magnirostris insidiatrix* (M.A. Carriker, Jr.); Guamalito, Dept. Santander Norte, on *Micrastur ruficollis zonothorax* (M.A. Carriker, Jr.); Choachi, Dept. Cundinamarca, on domestic pigeon (Hno. Apolinar-María); Acevedo, Río Suaza, Aguas Claras near San Adolfo, 1400 m., Dept. Huila, on *Chamaepetes g. goudotii* (P. Hershkovitz); 4 kilom. N.E. of Bellavista, near Río Porce, 1200 m., Dept. Antioquia, on *Ortalis columbiana caucae* (P. Hershkovitz).

VENEZUELA (recorded by Walker, 1849; Bau, 1929): Naiguata Peak, Distrito Federal (E.G. Holt); Arabupú, Mt. Roraima, State of Bolivar (A.S. Pinkus); Paulo, at foot of Mt. Roraima, State of Bolivar, on *Buteo m. magnirostris* (T.D. Carter); Rancho Grande, between Maracay and Ocumare-de-la-Costa, State of Aragua, on *Penelope a. argyrotis* and *Urubitornis s. solitaria* (W. Beebe); La Sierra Cojedes, State of Cojedes, 1000 m. (M. Villegas and H. Gines); Caracas (Gellmer); Mérida, on *Accipiter erythrocnemius*

venezuelensis and on "gavilan" (P. Anduze); Zumbrador, State of Mérida (J.D. Smith); Río Charaito, State of Miranda (G. Vivas-Berthier).

Brazil (recorded by Leach, 1817; Lutz, Neiva and da Costa Lima, 1915; Bau, 1929; Falcoz, 1930): without precise locality (Leach's ♀ type of *erythrocephala*); Nova Teutonia near Itá, State Santa Catharina, on *Ictinia plumbea* (F. Plaumann); Rio Grande do Sul (Stiegmayr); São Paulo (J. Lane); Taguara do Mundo Novo, State Rio Grande do Sul, on bird of prey (Strasbourg Mus.); Humboldt, State Santa Catharina, on *Spizaëtus tyrannus* (W. Ehrhardt); Cachoeira, State Rio Grande do Sul, on *Caracara plancus brasiliensis* and *Falco f. femoralis* (W.F. Henninger); Itaqui, State Rio Grande do Sul, on *Falco sparverius eidos* (W. Garbe) and on *Amazona vinacea;* Nova Wurttemberg, State Rio Grande do Sul, on *Spizaëtus ornatus;* São Paulo, State São Paulo, on *Nycticorax nycticorax hoactli;* Sto. Amaro, State São Paulo, on *Buteo m. magnirostris* (Juliani), Porto Cabral, on *Daptrius a. americanus* (J. Lima); Rio Paraná, State Matto Grosso; Guaratuba, State Paraná (A. de St. Hilaire); Paraná (E.D. Jones); Joinville, State Santa Catharina, on *Elanus l. leucurus* (W. Ehrhardt); Theresopolis, State Santa Catharina.

Ecuador: Baños, Prov. Tungurahua, on small owl (W. Clarke-MacIntyre); Balzapampa (W. Clarke-MacIntyre).

Peru (recorded by Thomson, 1869, as *O. gemina;* Brèthes, 1920; Falcoz, 1930): Tambopata, San Juan, Sandia, Puno, 5000 ft., on domestic fowl (2 ♀) and *Xanthornus decumanus maculosus* (Mrs. H.H. Heller); Yurimaguas, Amazonia, on *Claravis godefrida* [*"Peristera geoffroyi"*]; San Ramon, Valle Chanchamayo, on *Falco deiroleucus* (W. Weyrauch); Pan de Azucar, Río Tarma, 1400 m., on *Oroaëtus isidori* and on wild pigeon (either *Leptotila verreauxi decipiens* or *Columba subvinacea bogotensis.* — W. Weyrauch); Huacapistana, Río Tarma, 1800 m., on *Columba a albilinea* and *Momotus momota chlorolaemus,* with Mallophaga attached (W. Weyrauch); Lima, on owl (C.H.T. Townsend) and on *Dives dives warszewiczi, Tyto alba contempta, Zenaida asiatica meloda* and *Zenaidura auriculata hypoleuca* (W. Weyrauch); Valle Chanchamayo (W. Weyrauch and at ParisMus.); Callao (J.J. Walker); Chilpes, 30 miles N.E. of Tarma, on *Pionus tumultuosus* (J. A. Griswold, Jr.); Maraynioc (or Marainioc), 20 miles N.E. of Tarma, on *Cathartes aura jota* (J.A. Griswold, Jr.); Trujillo, on *Asio flammeus suinda* (J. Ortiz de la Puente); Hacienda Cadena, Marcapata, Dept. Cuzco, 1000 m., on *Oroaëtus isidori, Mi-*

crastur gilvicollis, Oreopeleia bourcieri frenata, and *Pipra chlorometos* (C. Kalinowski); Chanchamayo, Dept. Junín, on "gavilan" (J.M. Schunke).

Bolivia: Santa Cruz de la Sierra, 450 m., Prov. del Sara, on *Amazona aestiva xanthopteryx,* with Mallophaga attached (J. Steinbach); Incachaca, 2500 m., on *Margarornis s. squamiger* (J. Steinbach); Huachi, Rio Beni (W.M. Mann).

Argentina (recorded by Falcoz, 1930): Campo Grande, Misiones, on *Ramphastos dicolorus* (S. Pierotti); Timbo Viejo, Dept. Burruyacu, Tucumán, on "gavilan" (Carbone); Misiones (E. Kivirikko); Río Salado, Chaco de Santiago (Wagner).

Uruguay: Laguna Mirim, on *Columba p. picazuro,* July 22 (G. Ivey).

Chile (recorded by Falcoz, 1930): Valparaiso (d'Orbigny).

O. erythrocephala is restricted to the New World, where it occurs on the continent from Canada to central Chile and Argentina, as well as on most of the West Indian islands.[37] The northmost record is from Fort Severn on the Hudson Bay (56° N.), and the southmost from Valparaiso (about 33° S.). In tropical America and the Antilles it is by far the most common bird-fly. Of the 223 localities where it was taken, 16 are in southern Canada, 56 in the United States, 19 in Central America (Mexico to Panama), 69 in the Antilles, and 63 in continental South America. Most North American records are from East of the 100th Meridian, showing the fly's preference for a moist and mild climate.

Known Nearctic Hosts of *O. erythrocephala* (verified individual records in parentheses). Ciconiiformes (1): *Botaurus lentiginosus* (1). Anseriformes (1): *Branta c. canadensis* (1). Falconiformes (56 and 3 undetermined hawks): *Accipiter cooperii* (4); *A. gentilis atricapillus* (1); *A. striatus velox* (7); *Buteo jamaicensis borealis* (3); *B. p. platypterus* (24); *Falco c. columbarius* (8); *F. peregrinus anatum* (2); *F. s. sparverius* (3); *Haliaëtus l. leucocephalus* (2); *Pandion haliaetus carolinensis* (2). Galliformes (2):* *Phasianus colchicus* (2). Columbiformes (1 undetermined pigeon). Strigiformes: *Strix n. nebulosa.* Coraciiformes (1): *Megaceryle alcyon* (1). Piciformes (1): *Sphyrapicus v. varius* (1).

Known Neotropical Hosts of *O. erythrocephala.* Ciconiifor-

[37] Bau's record of *O. haitiensis* from New Caledonia (1929*b*, p. 11) was due either to an erroneous locality label or to a misidentification.

mes (5) : *Butorides virescens maculatus* (2) ; *Leucophoyx t. thula* (1) ; *Nyctanassa v. violacea* (1) ; *Nycticorax nycticorax hoactli* (1). Falconiformes (60 and 6 undetermined hawks) : *Accipiter b. bicolor* (1) ; *A. erythrocnemius chionogaster* (1) ; *A. erythrocnemius salvini* (1) ; *A. erythrocnemius venezuelensis* (1) ; *A. gundlachi* (2) ; *Buteo* sp. (1) ; *B. j. jamaicensis* (12) ; *B. jamaicensis costaricensis* (1) ; *B. jamaicensis umbrinus; B. m. magnirostris* (2) ; *B. magnirostris argutus* (1) ; *B. magnirostris insidiatrix* (1) ; *B. m. melanoleucus* (1) ; *B. platypterus antillarum* (2) ; *B. platypterus cubanensis* (2) ; *B. platypterus rivieri* (2) ; *Buteogallus anthracinus cancrivorus* (1) ; *Caracara plancus brasiliensis* (1) ; *Cathartes aura jota* (1) ; *Circus cyaneus hudsonius* (1) ; *Coragyps atratus foetens; Daptrius a. americanus* (1) ; *Elanoides forficatus yetapa* (1) ; *Elanus l. leucurus* (1) ; *Falco* sp. (1) ; *Falco c. columbarius* (2) ; *F. deiroleucus* (1) ; *F. f. femoralis* (1) ; *F. peregrinus anatum; F. sparverius caribaeorum* (1) ; *F. sparverius dominicensis* (1) ; *F. sparverius eidos* (1) ; *F. sparverius loquaculus* (3) ; *Herpetotheres c. cachinnans* (1) ; *Ictinia plumbea* (1) ; *Leucopternis princeps* (1) ; *Micrastur gilvicollis* (1) ; *M. ruficollis zonothorax* (1) ; *Odontriorchis palliatus* (1) ; *Oroaëtus isidori* (2) ; *Spizaëtus ornatus* (1) ; *S. tyrannus* (1) ; *Urubitornis s. solitaria* (1) : Galliformes (12) : *Chamaepetes g. goudotii* (2) ; *Dactylortyx thoracicus* (1) ; **Gallus gallus bankiva* (1) ; *Odontophorus* sp. (1) ; *O. guttatus veraguensis* (1) ; *O. strophium* (1) ; *Ortalis colombiana caucae* (1) ; *Penelope a. argyrotis* (1) ; *P. argyrotis colombiana* (1) ; *P. m. montagnii* (1) ; *Penelopina nigra* (1). Gruiformes (1) : *Eurypyga helias major* (1). Columbiformes (42 and 3 undetermined pigeons) : *Claravis godefrida* (1) ; *Columba a. albilinea* (3) ; *C. i. inornata* (2) ; *C. leucocephala* (4) ; **C. l. livia* (1) ; *C. p. picazuro* (1) ; *C. squamosa* (1) ; *Columbigallina passerina portoricensis* (1) ; *Geotrygon versicolor; Leptotila j. jamaicensis* (1) ; *L. v. verreauxi* (1) ; *Oreopeleia bourcieri frenata* (1) ; *O. caniceps leucometopius* (1) ; *O. chrysia* (2) ; *O. linearis infusca* (1) ; *O. m. montana* (5) ; *O. mystacea sabae* (1) ; *O. violacea albiventer* (1) ; *Zenaida a. asiatica* (4) ; *Z. asiatica meloda* (1) ; *Z. a. aurita* (2) ; *Z. aurita zenaida* (4) ; *Zenaidura auriculata hypoleuca* (1) ; *Z. m. macroura* (2). Psittaciformes (8) : *Amazona aestiva xanthopteryx* (1) ; *A. guildingii* (1) ; *A. l. leucocephala* (1) ; *A. ventralis* (1) ; *A. vinacea* (1) ; *Aratinga nana; Pionus sordidus saturatus* (2) ; *P. tumultuosus* (1). Cuculiformes (2) : *Piaya cayana mehleri* (1) ; *Saurothera v. vetula; S. vetula vieilloti* (1). Strigiformes (10 and 2 undetermined owls) : *Asio flammeus suinda* (1) ; *A. flammeus portoricensis*

(1); *A. stygius siguapa* (1); *Glaucidium siju* (1); *Otus n. nudipes* (1); *Pseudoscops grammicus* (2); *Strix* sp. (1); *Tyto alba contempta* (1); *Tyto alba furcata* (1). Caprimulgiformes (2): *Chordeiles minor gundlachii* (1); *Siphonorhis a. americanus* (1). Trogoniformes (2): *Pharomachrus m. mocino* (1); *Temnotrogon roseigaster* (1). Coraciiformes (1): *Momotus momota chlorolaemus* (1). Piciformes (3): *Melanerpes lherminieri* (1); *M. s. superciliaris* (1); *Ramphastos dicolorus* (1). Passeriformes (9): *Corvus jamaicensis* (2); *Cyanolyca pulchra mitrata* (1); *Dives dives warszewiczi* (1); *Holoquiscalis jamaicensis gundlachii* (1); *Margarornis s. squamiger* (1); *Myiobius barbatus atricaudus* (1); *Pipra choloromeros* (1); *Platypsaris niger; Xanthornus decumanus maculosus* (1).

Bionomics. *O. erythrocephala* is a typical polyxenous fly. In the Neotropics, where it occurs the year round, it is known from 97 native species (and additional subspecies) of 13 orders: Falconiformes (30), Columbiformes (21), Passeriformes (9), Galliformes (8), Psittaciformes (8), Strigiformes (6), Ciconiiformes (4), Piciformes (3), Trogoniformes (2), Cuculiformes (2), Caprimulgiformes (2), Coraciiformes (1), and Gruiformes (1). The Falconiformes and Columbiformes head the list and are certainly the chief true breeding hosts, as shown by the verified records: of a total of 164, two-thirds are from these two orders, namely 66, or 39 per cent, from Falconiformes and 44, or 27 per cent, from Columbiformes. The Psittaciformes are probably also breeding hosts, in spite of the few records now available. The captures on the remaining 10 orders are so scattered, that they must be based mainly on strays, except perhaps for the Galliformes and Strigiformes. In the Nearctic Region, where the fly has been taken on 15 native birds of 7 orders, the Falconiformes are even more favored, with 10 host species and 59, or 92 per cent, of the 64 verified records. Of the 10 Raptores listed as hosts from temperate North America, 5 harbor the same fly in the Neotropics. *O. erythrocephala* seems to shun the Columbiformes in the Nearctic Region, as there is only one record, possibly a stray occurrence on a domestic pigeon. The limited host range and relative scarcity north of Mexico, in spite of more intensive collecting, suggest that *O. erythrocephala* may be only an adventitious or seasonal member of the Nearctic fauna. A study of the northern seasonal occurrence further supports this view. The fly has been taken from March 18 on (in New York), through April (Illinois, New York, Nebraska), May (Maine, Michigan, Massachusetts, Montana, Ohio, Maryland,

New York, Minnesota), June (Quebec, Kansas), August (Quebec), September (New York, Illinois), October (New York), and November (New York, to Nov. 16). There is no evidence that it survives as adults in temperate North America on any resident host during the winter or that it hibernates as puparia. It is even doubtful that it breeds to any great extent during the summer in that area. I suspect that it is introduced there afresh every spring on some of its migratory breeding hosts, which might explain why it is so specific of diurnal birds of prey in the United States and Canada, the seasonal migrations of many of these birds being very regular and covering a wide territory.

What little else is known of the life-history of *O. erythrocephala* is reviewed in Part I, pp. 156 (infestation with mites), 172 (phoresy of Mallophaga), and 328 (host relations). The following is an additional case of phoresy: a female on a parrot, *Amazona aestiva xanthopteryx,* at Santa Cruz de la Sierra, Bolivia, carried 4 Mallophaga near dorsal tip of abdomen. A male from Mérida, Venezuela, on "gavilan," has several small mite clusters on the dorsum of the abdomen. Puparium as yet unknown.

Affinities. *O. erythrocephala,* one of the species with relatively short upper orbits, is most nearly related to *O. orizabae,* from which it differs in the shape of the antennal appendage and of the interocular face, as shown in the key. The extensive synonymy results mainly from undue reliance upon variations in the color of the integument and pilosity, which are of little value, as usual in Hippoboscidae. Speiser (1904*a*, pp. 344–345) recognized that the color of the frons ("labium supra os" of Rondani; "clypeus" of Speiser), used by Rondani to separate *bellardiana* from *erythrocephala,* was unreliable. He retained, nevertheless, *erythrocephala, bellardiana* and *haitiensis* as distinct because of other color differences, shown in the subjoined key, while admitting that all three might perhaps be treated rather as varieties.

1. Scutellum dark blackish-brown throughout, at most with a trace of yellowish tinge basally. Bristles of antennal appendage reddish-yellow ..... *O. erythrocephala*
   Scutellum broadly yellowish-brown basally, almost over half the surface 2
2. Bristles of antennal appendage reddish-yellow ..... *O. bellardiana*
   Bristles of antennal appendage black or at any rate mixed with black ..... *O. haitiensis*

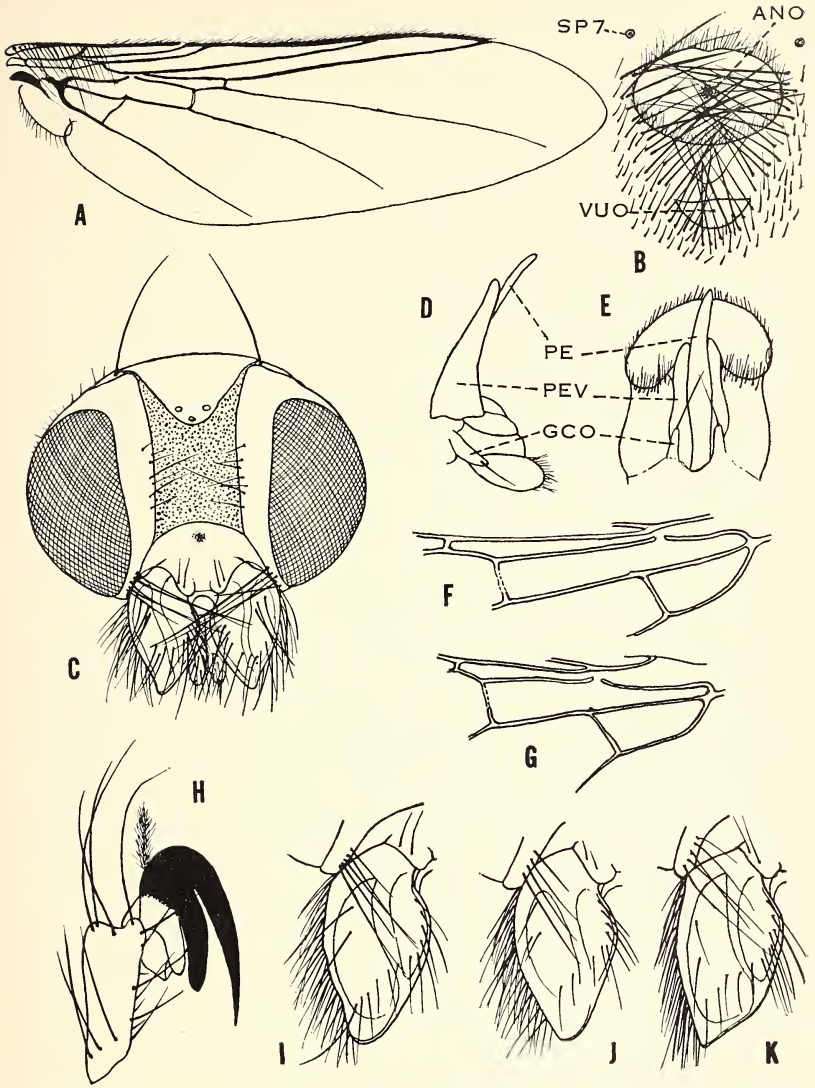

Fig. 38. *Ornithoctona erythrocephala* (Leach). **A**, wing, ♀ type of *O. costaricensis* Swenk, Juan Viñas; **B**, tip of abdomen, ♀, Concord, on *Falco c. columbarius: ANO*, anal opening; *SP7*, 7th abdominal spiracle; *VUO*, vulvar opening; **C**, head, ♂, Orient, on *Accipiter striatus velox;* **D–E**, ♂ terminalia in side view (**D**) and from below (**E**), Orient, on *Accipiter striatus velox: GCO*, gonocoxite; *PE*, penis; *PEV*, penis valves; **F–G**, basal and anal cells of ♀, St. Vincent, on *Buteogallus anthracinus cancrivorus* (**F**), and Mérida, on "gavilan" (**G**); **H**, distitarsus and claw of hind leg, ♀, St. Vincent; **I–K**, antennae of ♀, Mérida (**I**), St. Kitts (**J**), and Joinville, on *Elanus l. leucurus* (**K**).

Falcoz (1930, pp. 39–40), realizing that Speiser's position was untenable, sunk *haitiensis* and *bellardiana* in the synonymy of *erythrocephala* (his "*hatamensis* Big." on page 40 was an obvious slip for *haitiensis*). My study of many specimens of the large American *Ornithoctona* leads to the same conclusion, as it is impossible to sort them consistently by the color of the scutellum and antennal bristles. Even striking color differences, shown by some flies, cannot be correlated with reliable structural characters or with peculiar geographical or host distributions. Flies taken from one individual bird may differ markedly in color.

The intraspecific variation in the shape of the 3rd antennal segment is more important. Unless it is properly recognized, it might induce misleading attempts to establish distinct species on extreme variants. The average or usual shape is shown in Fig. 38*J*, in which the inner and outer margins of the appendage converge about equally and gradually over the apical third into a broad, triangular, blunt apex, with somewhat upturned edges. Departures from this are in two directions: in some flies (Fig. 38*K*) the triangular, blunt apex of the appendage is irregular and shorter, extending only over the apical fifth; in others (Fig. 38*I*), the apical portion is very broad throughout and the apex is not definitely triangular. Transitions connect all three types, making it impossible to group the specimens consistently on this basis.

The relative length of the anal and 2nd basal cells also varies: the anal may be less than half the length of the 2nd basal, or about half as long, or even slightly more than half (Figs. 38*A*, *F–G*). There is no trace of an extra vein in the axillary cell.

As noted by Falcoz (1930, p. 39), the sexual differences of the abdomen are rather conspicuous. In the male, the basal sclerite (combined 1st and 2nd pleurotergites) is short, covered with strong, stiff, curved, almost hook-like setae, longer at the sides; elsewhere the dorsum bears many evenly scattered, short setae; it carries 3 wide but short sclerites, each 4 times as wide as long, fringed with longer setae at the hind margins; a pair of small, setigerous sclerites flank the anal opening; ventrally the integument is membranous and covered with short setae, except for the narrow, trapezoidal, basal sclerite; the genital orifice is surrounded by long setae; terminalia (Figs. 38*D–E*) as in *Ornithomyia*, but gonocoxites more prominent. In the female, the dorsum of the abdomen lacks median sclerites behind the combined basal pleurotergites; it is uniformly covered medially with short setae, with longer setae at sides and toward apex; there are two small, setig-

erous, lateral, preänal sclerites; female genital opening as in Fig. 38*B*. The male is smaller than the female, with a wing length of 7.5 to 8 mm. (8 to 10.5 mm. in the female).

Original description of *O. erythrocephala:* "O. corpore perfusco, capite rubro, pedibus fuscescentibus. Caput rubrum infra sordide viridescente-testaceum: labium [frons] albidum. Thorax perfuscus antice sordide testaceus: scutellum perfuscum: pectus sordide viridescente-testaceum: alae pallide fuscescentes: pterigostea [wing veins] marginalia fusca, limbalia albida: pedes fuscescentes infra sordide viridescente-testacei: tarsi quatuor anteriores sordide testacei nigro-marginati, postici nigri: ungues atri. Abdomen luteum nigricante-hirsutum: dorsum saturatius." There is a brief diagnosis on p. 7: "Corpore perfusco, capite rubro, pedibus fuscescentibus." I have seen the ♀ type in 1951 at the British Museum. Speiser (1902) and Austen (1903) recognized that it is the common large American species of *Ornithoctona.* The parts originally described as dull-greenish have now turned dirty-yellow, without a trace of green. According to Dr. G.B. Fairchild (*in litt.,* 1953), the wing is 9.6 mm. long.

Original description of *O. nebulosa:* "Head yellow; feet pale; tibia with two reddish-brown lines. Eyes blackish-brown; vagina and hypostoma, pale; thorax reddish-brown, with a large yellowish humeral spot and three longitudinal lines, of which the intermediate one includes an impressed line, which interrupts a transverse impressed line; humeral angle prominent, subacute; spiracle white; marginal nervures blackish-brown, those of the disk brown; scutel reddish-brown, varied with yellow at base; pectus [sternum] yellow-white, anterior margin bifurcated; tarsi dark reddish-brown, nails black; abdomen pale-brownish, with black hair, first segment on its anterior face pale-yellow. Length $\frac{3}{10}$ inch [7.5 mm.]." The type is lost; but the description and size agree exactly with *O. erythrocephala,* and there is no other large hippoboscid in the United States that could possibly fit it. The statement about the bifurcated anterior margin of the sternum should particularly be noted. It is remarkable that *erythrocephala* has not been taken again on the type host of *nebulosa,* although there are records from other species of owls in the West Indies and South America.

Original description of *O. gemina:* "Lata, testacea, thorace apice emarginato, postice piceo, abdomine supra fusco; fronte ocellis distinctis, utrinque linea subarcuata impressa; alis flavescentibus, nervo transverso-ordinario pone posteostae exitum sito. ♀ Long. 8 mill. Caput parvum, margine postice arcuato thoraci bene adaptatum; fronte [interocular face] linea utrinque integra, subincurva impressa; epistomate [frons] brevi, postice arcu impresso a fronte [interocular face] discreto; antennis magnis, lamellatis, horizontaliter deplanatis, ovalibus, glabriculis, margine externo acuto densius et interno parcius fulvo-setosis; palpis brevibus, vix corneis, sub antennis occultis; oculis maximis lateralibus, testaceis, pupilla interiore nigra ovali rotunda. Thorax apice semicirculariter emarginatus, callo humerali nigro-setoso, spinoso-producto; scutello transverso, margine postico late rotundato. Alae nervis corneis, costali cum ramo submarginali in 6:a parte posteriore conjuncto ibique desinente, abscissa 2:a 3:a sextuplo longiore, hac quam nervo transverso vix longiore, 4:a 5:a saltim duplo longiore; post-costali medium alae haud attingente; transverso-ordinario pone posteostae exitum, ante medium alae sito: cellula humerali longa, nervo transverso subobliquo, pallido, mox ante posteostae exitum sito, occlusa; anali nervo transverso bene occlusa. Abdomen latum, suturis inter segmenta vix conspicuis. Pectus [sternum] testaceum, inter coxas anticas utrinque spinoso-productum. Pedes intermedii posticis longiores, testacei, parce pilosi; tibiis linea superna et inferiore nigro-picea notatis; tarsis posticis articulo 1:o 5:o breviore, hoc unguiculis 3-dentatis, pulvillis magnis et empodio distincto praedito." The type, which I saw at the Stockholm Museum in 1933, is a ♀ of *O. erythrocephala,* as Speiser (1904) recognized.

Original description of *O. bellardiana:* "Long. mill. 7–8. Corpus nigropiceum; capite, margine anteriore thoracis aut saltem humeris, scutelli vitta basali magis vel minus manifesta, vel rubescente-testaceis vel rufis. Oris labium [frons], et antennae capite concoloria; istis latis et longis, organa oralia tegentibus, et fulvo-pilosis. Abdomen dorso nigricante, basi plus minusve anguste pallida, apice luride albicante, ventre obscure fusco. Alae paulo et aequaliter fuscescentes etiam angulo interiori: vena secunda longitudinale costam attingente contra, nisi fere ante transversam exteriorem: distantia tertiae in costale a secunda, magis quam dupla distantiae a quarta: vena transversa intermedia longior aut sub-aequale distantia ab exteriore. Pedes sordide glauci, femoribus superius fuscis: tibiis antice et postice anguste nigricante-marginatis: tarsis obscuris, posteriorum articulis basalibus intus sub-glaucis." Rondani placed his species among those with last section of costa somewhat shorter than penultimate section. He stated that it differed from *O. batchiana* and *O. hatamensis* [both synonyms of *Ornithoctona plicata* v. Olfers] in the "pilis antennarum fulvescentibus non nigris"; and from *O. erythrocephala* in the "labro supra os [frons] non albido, sed capite rufescente concolore; abdomine non luteo sed nigricante." He described more than one specimen, at least one being kept in his collection, its present location being unknown. Another was probably returned to the Genoa Museum, where I have seen a ♀ of *O. erythrocephala* now labelled "*pyrrhocephala* Rondani." I agree with Speiser (1904), who also saw this fly, that this was no doubt an earlier manuscript name given by Rondani to what he later called "*bellardiana,*" so that I regard it as one of the cotypes. Speiser found the color of the frons unreliable; but he thought that *bellardiana* and *erythrocephala* could be separated by the color of the scutellum and of the setae of the antennal appendages, though admitting that these also might be variable, so that possibly the two forms should be regarded as varieties of one species. A large series of *erythrocephala* shows that all these color variations, not only intergrade, but are influenced by extraneous factors, such as age.

Original description of *O. haitiensis* (French text translated): "Long 7 mm. Antennis et capite fulvis, nitidis, nigro setosis. Thorace nitido, flavido-fulvo, macula fusca transversa, lata, subcordiformi, notato; scutello nitido, fusco, utrinque, basi, pallide fulvo; abdomine castaneo, opaco, basi obscure fulvido; pedibus fulvis, tarsis apice, posticis, omnino, fuscis, femoribus posticis et intermediis linea exili laterali, tibiis superne et inferne, angustissime fuscis; alis pallide flavidis, venis, costali, longitudinalibus 1–4is, omnino, 5a et 6a, usque ad venas transversas, nigris, transversali 1a nigra, 2a pallida. Head and antennae fulvous, with black setae; epistoma [frons] with a rounded pit; vertex [postvertex] and sides of frons [inner orbits] shiny; ocelligerous spot blackish; thorax and scutellum shiny; the former pale fulvous with a large, nearly heart-shaped, brown dorsal spot; the latter brown with two yellowish basal spots at sides and with fairly numerous black, stiff setae near hind margin; abdomen dull, brownish with somewhat yellowish base; legs fulvous-yellow, with rather long black bristles; tips of tarsi (hind tarsi entirely) blackish; a thin, longitudinal brown line on outer face of mid and hind femora; all tibiae margined with brown above and below; wings pale yellowish; costa and 1st to 4th longitudinal veins entirely, 5th and 6th longitudinals as far as cross-veins, blackish; 1st or outer [anterior] cross-vein blackish, the 2nd [anterior basal] white; 1st and 4th longitudinals (of Rondani's terminology) ending in costa not far from each other, a little beyond inner [anterior basal] cross-vein; 3rd reaching costa close to 4th; two basal cells fairly unequal." Speiser (1902) examined the type, now in Mr. J.E. Collin's collection, where I also saw it (1951). He recognized that it was closely related to *erythrocephala,* but thought that it differed in a reliable color character of the scutellum. He stated also: "According to the original description, *erythrocephala* has the scutellum 'perfuscum,' which color is also present in many specimens seen by me. On the other hand, in *O. haitiensis* the scutellum is broadly yellow at the base, as

Rondani described it also for his *O. bellardiana.* Bigot's species differs from *bellardiana* clearly in the black, not reddish-yellow setae of the antennal appendages. The clypeus [frons] of *haitiensis* is not as bright reddish-yellow as in most other specimens referable to the same species group, yet is not strictly white. I do not believe, moreover, that Leach's specimen had actually a white clypeus (which Leach calls the labium); for, if Leach's species is actually as widely distributed and occurs on as great a variety of birds as Walker mentions, I should have found at least one with a white clypeus among the many specimens of the group now before me. Concerning the shape of this clypeus [frons] in *O. haitiensis,* it should also be noted that, while it looks angularly emarginate in the middle of the anterior margin when seen from above, it is found, upon more careful examination, that the slightly convex clypeus [frons] is sunken between the antennal appendages and bears here, exactly in the middle, a deep pit, which, moreover, is set off by its dark brown color from the pale yellowish-brown surrounding area. The small pit at the hind margin, also present in *O. erythrocephala,* was previously noted by Bigot. Concerning the venation, it may be mentioned briefly that the subcosta ends in the costa mid-way between the anterior and the posterior cross-veins, the last section of the costa is over half the length of the penultimate, the second basal cell is shorter than the first for about the length of the posterior cross-vein and twice as wide as the first, and the anal cell is about exactly half as long as the 2nd basal cell. Legs without peculiarities; color of tarsi as described for *O. erythrocephala.*'' I have discussed before Speiser's later (1904) attempt to distinguish 3 species in what I can only regard as the one *O. erythrocephala.*

Original description of *O. robusta:* ''♂ ♀. Brown; front, antennae and legs rufous; wings brownish-hyaline; first vein ending in the costa above the small cross-vein; 4th portion of the costa much longer than 5th. Length 7 mm. The ocelli are less conspicuous than in *O. avicularia* and only recognizable in the 3 impressed points on the posterior frontal plate. Front [interocular face] rufous and, except the median space, very glossy, in the ♂ as broad as the eyes, in the ♀ much broader; antennae coniform, rufous, and hairy. Thorax reddish-brown; the humeral prominences [callosities] dentiform. Abdomen dark brown. Legs rufous; femora thick and, as well as the tibiae, with long bristly hairs; the foot-claws black, strong. Wings brownish; 1st vein reaching the costa above the small cross-vein, which stands distinctly before the middle of the wing; the auxiliary vein reaches the costa near the end of the 1st vein, the 2nd vein close to the termination of the 3rd (the 3rd portion of the costa, that is, between the auxiliary and the 1st veins, thus being very small and the 4th portion very large and much longer than the 5th); the 2nd basal cell is a little shorter than the superior [first], and the cross-vein by which it is closed is often inconspicuous; the inferior basal cell (anal cell) is trigonal and rather indistinct. In its large size, general facies, neuration of the wings, etc., this species much resembles *O. columbae* Wiedem. from Java, Borneo, etc., but is probably distinct, the habitat being very different.'' Austen (1903) recognized that all 5 cotypes were ♀ (not 1 ♀ and 4 ♂, as v. d. Wulp stated), and that they could not be separated from *O. erythrocephala,* a conclusion with which I agree after seeing the specimens in 1951. According to Dr. G.B. Fairchild (*in litt.,* 1953), the length of the wings is as follows: ♀ with type label, from Caché, 10 mm.; ♀ from Volcán de Chiriqui, 10.2 mm.; ♀ from Zapote, 9.5 mm.; ♀ from Jalapa, 9.6 mm.

Original description of *O. buteonis:* ''Length 7–7.5 mm. Head yellowish-brown, the broadly crescentic orbital margins and the vertex [postvertex] polished, the median area opaque. Clypeus [frons] convex, slightly emarginate and rather weakly pitted anteriorly and bearing a small round pit on the posterior margin. Antennary processes distinctly less than twice as long as broad, clothed with bright pale ferruginous hair, broadly lanceolate owing to both margins being evenly convex, the tips narrowly rounded. Eyes light brown. Thorax

above fuscous-brown, paling to testaceous on the humeral angles, the inner margins of the dentiform processes and the adjacent spiracle whitish. Mesoscutum with a feeble median impressed line and deep, sinuate, lateral median transverse impressed lines. Scutellum fuscous brown, strongly tinged with reddish on the anterior margin, discally shallowly depressed, and bearing a row of about a half dozen short black hairs near each margin. Under side of head and thorax pale testaceous, the labium whitish at tip. Legs above reddish-brown, below pale testaceous, the tibiae with the edges fuscous, the tarsi fuscous, the claws black. Abdomen yellowish, copiously but not densely clothed with short, black hairs. Wings clear, the costal veins and bases of the longitudinal veins dark brown, the 1st longitudinal vein ending in the costa at a point nearly above the 1st cross-vein, the costal border of the marginal cell about one fourth longer than the costal border of the 1st submarginal cell and the 1st cell more than the length of the 2nd cross-vein longer than the 2nd basal cell. Belongs to the *O. erythrocephala* group. Agrees with *O. erythrocephala* Leach, of Brazil to Mexico and the West Indies, in size and venation, but differs in the reddish-brown rather than ferruginous head, the concolorous clypeus [frons], the darker legs and the reddish anterior border of the scutellum. *O. nebulosa* Say, from the western United States, is the same size, but differs in the clypeus [frons] being pale (concolorous with the rest of the head in *buteonis*), and the reddish-brown mesonotum with three yellowish lines (fuscous-brown without markings in *buteonis*). From *O. fusciventris* Wiedemann, described from Kentucky, *buteonis* differs in larger size (*fusciventris* is only 5 mm. long), somewhat less deeply emarginate anterior border of clypeus [frons] (deeply and angularly emarginate in *fusciventris*), flattish scutellum (basally inflated in *fusciventris*) and in the coloration of the thorax being much darker than the head (concolorous in *fusciventris*). *O. pilosula* van der Wulp, from Costa Rica, is smaller (5.5 mm.) and has the head and thorax rufous. *O. haitiensis* Rondani, from Haiti, is distinct in its dark-haired antennae and different venation, the 1st longitudinal vein ending in the costa before the 1st cross-vein. This latter venational character will also separate *O. avicularia* Linnaeus, the common European species, and *O. varipes* Walker, of Mexico to Colombia and Peru, the latter further differing in the shape of the antennary process. *O. anchineuria* Speiser (= *O. pallida* Say) may be distinguished at once by the interstitial 1st and 2nd cross-veins, making the 2nd basal cell nearly as long as the 1st basal cell (much shorter in *buteonis*). The coloration is entirely different from *O. butalis* Coquillett, described from Bering Island.'' I was able to study the holotype and paratypes of *buteonis* at the University of Nebraska in 1940 and again in 1953. Both are ♀ and agree in every structural detail with *O. erythrocephala*. The supposed differences pointed out by the author have in my opinion no specific value in the genus *Ornithoctona*. The wing of the holotype is 10.4 mm. long.

Original description of *O. costaricensis:* ''Length 7 mm. Front [clypeus] and vertex wholly glossy bright ferruginous, the posteriorly broadening orbital margins and the vertex triangle [postvertex] perfectly smooth and polished, the median area microscopically tesselated, giving it a satiny luster, and of subuniform width. Clypeus [frons] concolorous with front [mediovertex] and vertex [postvertex], anteriorly medially emarginate because of a deep rectangular pit, posteriorly also with a large, deep, oval pit. Antennary processes twice as long as broad, their sides convex and their tips narrowly rounded, of a darker ferruginous color than the clypeus and front and provided with long, ferruginous hairs. Eyes glossy black. Humeral prominences pale, heavily black-haired. Mesonotum shining blackish, slightly suffused with reddish along the anterior sutures, bearing a faintly impressed median line and deep, slightly curved, transverso-median depressions on each side of it. Scutellum rounded posteriorly, medially much depressed transversely and this depression bearing several long, black hairs, shining black like the mesonotum but with the anterior margin red-

dish testaceous, interrupted medially by a blackish stain. Sternum and under side of head greenish testaceous. Legs beneath greenish testaceous, above fusco-testaceous, becoming dusky on the tibiae, fuscous on the tarsi and with the claws black. Abdominal tegument dark brown, but so heavily clothed with black hairs as to appear blackish. Wings slightly clouded, the costal veins and bases of the longitudinal veins blackish, the 1st longitudinal vein ending in the costa slightly before the 1st cross-vein, the costal border of the marginal cell fully twice as long as the costal border of the 1st submarginal cell, and the 1st basal cell twice the length of the 2nd cross-vein longer than the 2nd basal cell. The shiny blackish mesonotum seems to distinguish this species from all of the described North American congeners except *O. butalis* Coquillett, which is much smaller (4 mm.), has the front black spotted on the orbits and vertex with yellow, and is otherwise very different. The species is really close to *O. erythrocephala,* but apparently differs in the deep anterior pit on the clypeus, the red anterior border on the scutellum, and, compared with van der Wulp's description of *O. robusta* which Austen places as a synonym of *erythrocephala* after a comparison of the types of both in the British Museum, it should also differ in darker legs and abdomen, although these color differences are not clear from a comparison with Leach's original description of *erythrocephala.* From *O. haitiensis* it differs at once in the ferruginous hairs on the antennary process, the dark legs and the different venation (the 1st longitudinal vein ends considerably before the 1st cross-vein and the costal border of the marginal cell is less than twice as long as the costal border of the 1st submarginal cell in *haitiensis*). The venational characters are much like those of *O. buteonis,* just described, and separate the species from several of its congeners.'' I examined the type of *costaricensis* at the University of Nebraska in 1940 and again in 1953 and found that it is a female of *O. erythrocephala.* The differentiating characters, mostly of color, mentioned in the description are not of specific value in this genus. The wing of the type is 10.5 mm. long.

Original description of *O. albiventris* (translated from the German): ''Of the group of *O. erythrocephala.* Abdomen grayish-white, densely and finely punctate with black, entirely bare above and below, hairy only at base, somewhat at side margins and more strongly at apex. Head bright red, anteriorly somewhat more pale yellowish. Vertex [interocular face] medially with a broad, flat depression [mediovertex], above the antennae with smaller depressions. Eyes brown. Ocelli brown. Antennal appendages with reddish-yellow setae. In the specimen seen, neck clearly visible and grayish-white. Notum dark bluish-gray, darker, almost black medially, paler on sides, with a well-marked, bright red, longitudinal streak and a strong transverse depression. Humeral protuberances more yellowish-gray, with black setae. Scutellum bluish-gray, scarcely paler basally, with fine markings of sculpture and with black setae posteriorly. Coxae and sternum yellowish flesh-color; upper femora of the same color, bearing only few, long black setae (as compared with related species). Fore tibiae without spur. Tibiae above bluish-gray, beneath yellowish flesh-color or dirty yellow, with many black setae. Tarsi blackish-gray, the segments somewhat yellowish in the middle above. Claws black. Wings pale brownish-gray. Venation not differing specially from *O. erythrocephala.* First two longitudinal veins (subcostales) end close together in costa shortly before and somewhat above small [anterior] cross-vein. Third section of costa very short, 4th section somewhat longer than 5th. Anterior [1st] basal cell narrow; posterior [2nd] broad, its width about $\frac{3}{4}$ of length of posterior cross-vein. Anal cell scarcely half the length of posterior [2nd] basal cell. Abdomen grayish-white, without any yellowish tinge, closely covered with fine small punctations, dorsally and ventrally entirely bare, black setose only at base (somewhat more strongly) and at sides (sparsely); with strong, black bristles around the black anus. Penultimate abdominal segment, at a distance from middle line of about $\frac{1}{3}$ of width of abdomen, with two large, black spots seemingly formed by densely

crowded, minute, swollen punctations. As stated before, anus black, with black setae. Total length of specimen in alcohol, 10.8 mm.; from mouth to hind margin of scutellum, 5.5 mm.; of wing, 10.5 mm.'' Bau says it differs from related species ''in the abdomen being completely bare above and below and in the sparsely setose upper femora. . . . The abdomen is grayish-white, punctate with black. In the other species the abdomen is yellowish-gray, brownish or blackish, always without black punctations.'' The description fits specimens of *erythrocephala* perfectly, and, although I have not seen the type, which should be at the Berlin Museum, I do not hesitate to synonymize *albiventris*. The black punctations of the abdomen were, I believe, the insertions of the usual short setae.

Ornithoctona orizabae, new species

Figs. 39*A*, 43*G–H*, and 44*B*

Male. Head (Fig. 43*G*) seen in front about $1\frac{1}{3}$ times as wide across eyes as high from occipital margin to bottom of frontal emargination. Interocular face at its narrowest about half the width of an eye, nearly twice as high as wide; inner eye margins slightly converging toward lower third. Inner orbit much less than half the width of mediovertex at its narrowest; orbital bristles few and weak: 3 or 4 (one very long) at side of lunula; a short row of 3 at about mid-height; 1 rather short vertical bristle. Upper orbit rapidly narrowed laterally, shorter than width of inner orbit at ptilinal suture. Postvertex broadly triangular, slightly wider than long, smooth, evenly rounded anteriorly; ocelli well developed, placed far down and close together; anterior ocellus much, and posterior ocelli slightly, below a line drawn through upper eye margins. Frons: lunula with a shallow basal depression, separated by a slight suture from the lower, very narrow and short interantennal portion, which is broadly emarginate at apex; apical arms short and weak, hidden beneath inner edges of antennal appendages. Antenna (Fig. 43*H*): 1st segment with 1 or 2 short setae, almost fused with lunula, except for a short, but deep groove at interantennal area of frons and a faint trace of a suture elsewhere. Appendage of 2nd segment about as long as half the height of head (from occipital margin to bottom of frontal emargination), longer in proportion to width than in most other *Ornithoctona* (except *O. nitens*), about 3 times as long as greatest width; basal $\frac{2}{3}$ nearly parallel-sided, apical $\frac{1}{3}$ gradually narrowed, triangular, with blunt apex; surface only superficially grooved, setulose as usual. Palpi short and thick, not extending beyond antennal appendages. Head beneath with many long bristles (vibrissae) in several irregular rows on side ridges of rostrum membrane. Thorax (Fig. 44*B*) as usual in *Ornithoctona,* but relatively narrower,

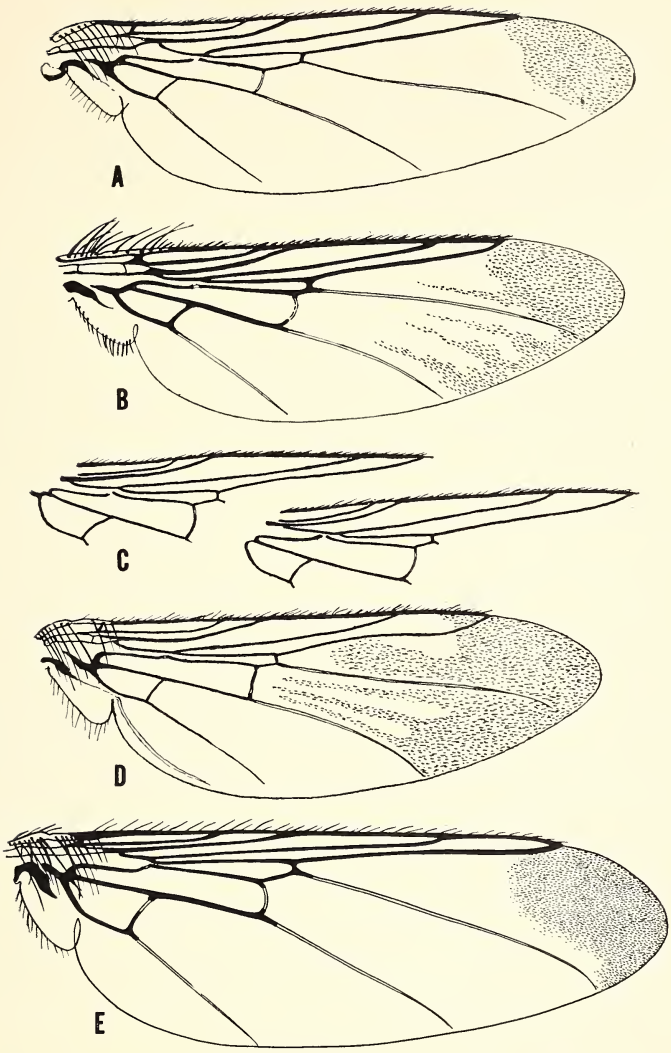

Fig. 39. Wings of *Ornithoctona:* **A**, *O. orizabae* J. Bequaert, ♂ holotype, Orizaba; **B–C**, *O. fusciventris* (Wiedemann), ♀, Nebraska (**B**), ♀, Usaquen (**C**, left), and ♀, Wellesley (**C**, right); **D**, *O. oxycera* Falcoz, ♀, El Jonquito; **E**, *O.* (*Ornithopertha*) *nitens* (Bigot), ♀, Turrialba, on *Trogon* sp.

longer and slightly more convex dorsally than in *O. erythrocephala;* scutellum relatively longer and more produced behind; ventrally, prosternal lobes somewhat curved. Chaetotaxy of thorax as in *O. erythrocephala,* except for a single notopleural bristle; other setae shorter and thinner than in that species. Legs unusually slender; femora much thinner than in *O. erythrocephala,* with weaker and sparser setae; tips of tibiae normal; hind basitarsus beneath with the usual transverse, basal comb of short setae. Wing (Fig. 39*A*) with typical *Ornithoctona* venation; but anterior and anterior basal cross-veins farther apart than usual (distance between them on 4th longitudinal more than length of anterior basal); relative length of anal and 2nd basal cells nevertheless about as in *O. erythrocephala;* no trace of extra vein in axillary cell; membrane with a patch of microtrichia in apical third of 1st posterior cell, not quite reaching 4th longitudinal and extending only slightly basad of tips of costa and 3rd longitudinal. Abdomen not suitable for an adequate description in its present shrivelled condition; the usual dorsal median sclerites of the male sex appear to be present, the preänal pair very large. Male terminalia, protruding distinctly from apex of abdomen, differing, so far as visible, little from those of *O. erythrocephala.* The dried, pinned type is colored like many *O. erythrocephala:* head mostly reddish-brown; thorax dark mahogany-brown with dirty-yellow humeral areas, scutellum and legs; wings slightly smoky throughout, with blackish-brown veins; setae of body, including those of antennae, black.

Length, from tips of antennal appendages to hind margin of scutellum, 5 mm.; of wing, 10 mm.; width of wing, 3 mm.; total length of dry, shrivelled specimen, 6.5 mm.

Mexico: Orizaba, State of Vera Cruz, from unknown host (A. Sallé), ♂ holotype (British Museum, Natural History).

Affinities. *O. orizabae* is closely related to the common *O. erythrocephala.* I have ventured to describe it from one specimen, because the narrow frons, combined with the peculiar shape of the 2nd antennal segment, seems to differentiate it clearly. Although the 2nd antennal segment varies in *erythrocephala,* that of *orizabae* is well outside the range of these variations.

Ornithoctona fusciventris (Wiedemann)

Figs. 39*B–C*, 40, 41, 42, 43*A–F*, and 44*C*

Ornithomyia fusciventris Wiedemann, 1830, Aussereurop. Zweifl. Ins., 2, p. 611 (no sex; no host. Kentucky. Type ♀ in Vienna Mus.). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No.

270, p. 213. Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 158 (Mexico: on *Piranga flava hepatica*). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654.

Ornithoctona fusciventris Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 348 (synonymy of *O. chilensis* Guérin); 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, pp. 303 and 304. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 315 and 317. Stuardo, 1946, Catálogo Dípteros Chile, p. 187. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, p. 403, figs. 238–239 (Michigan: East Lansing, on *Hedymeles ludovicianus*. Illinois: Beach, on *Accipiter striatus velox*. Minnesota: on *Hedymeles ludovicianus*. Wisconsin: Milwaukee Co., on *Wilsonia canadensis*). Thompson, 1949, Ent. Mo. Mag., **85**, p. 248 (Jamaica: Newcastle Road, St. Andrew, on *Seiurus a. aurocapillus;* Hermitage, St. Andrew, on *Mniotilta varia*). J. Bequaert, 1950, Agricultura Técnica, Santiago de Chile, **10**, pt. 1, p. 8.

Ornithomyia chilensis Guérin-Méneville, 1835, Iconographie Règne Animal, Insectes, Atlas, Pl. 104, fig. 5 (with name; dated as drawn November, 1835; no locality or description. Type probably lost). Macquart, 1843, Mém. Soc. R. Agric. Arts Lille, (for 1842), p. 437 (no sex; no host. Chile. Described as a new species, but based on the same specimen as Guérin's species, which Guérin sent to Macquart) [1843, Dipt. Exot., **2**, pt. 3, p. 280]. Not of E.P. Reed, 1904.

Ornithomyia chiliensis Guérin-Méneville, 1844, Iconographie Règne Animal, Insectes, Text, p. 556 (no sex; no host. Chile. Type from "Voyage de la Coquille," probably lost). Girard, 1885, Traité Elémentaire d'Entomologie, **3**, p. 1068; Atlas, Pl. 116, fig. 5 (copy of Guérin's fig. of 1835, uncolored).

Ornithoctona chilensis J. Bequaert, 1933, Rev. Chilena Hist. Nat., **37**, p. 163.

Ornithomyia testacea Macquart, 1845, Mém. Soc. R. Sci. Agric. Arts Lille (for 1844), p. 346 (no sex; no host. Colombia. Type originally in Fairmaire Coll., later in Bigot Coll., now in J. E. Collin Coll.) [1846, Dipt. Exot., Suppl. **1**, p. 218]. J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 417.

Ornithoctona testacea Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 180 (redescription of type in J. E. Collin Coll.).

Ornithomyia varipes Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1146 (no sex; no host. Colombia. Type ♀ at Brit.Mus.). Speiser, 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41**, p. 348 (regards it as distinct from *O. obscurata* Walker); 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 417.

Ornitheza (?) *varipes* Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 262 (in part: Walker's type, van der Wulp's specimen of "*O. avicularia*" from Río Sucio, Costa Rica, and the specimens from Huamachuca, Peru, 3000 m., and Orizaba, Mexico). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 653.

Ornithomyia pilosula van der Wulp, 1903, Biol. Centr.-Amer., Diptera, **2**, p. 432; Pl. 13, figs. 6–6*a* (? ♀; no host. Costa Rica: Volcán de Irazú. Type ♀ at Brit.Mus.). Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 262 (type; says it is probably an *Ornitheza*). Speiser, 1907, Ent. News, **18**, p. 103 (says it is not an *Ornitheza*); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Ornitheza pilosula Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 653. Bau, 1929, Zoolog. Anzeiger, **85**, p. 11 (Brazil: Conganhas).

Ornithoctona parva Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 180 (no sex; no host. Colombia. Description of a specimen called *O. parva* by

Macquart in Bigot's Coll., now in the J. E. Collin Coll., but not Macquart's type). Not *Ornithomyia parva* Macquart, 1843.

Ornithomyia parva J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., 3, No. 12, p. 417 (Speiser's specimen from Colombia).

Ornithomyia avicularia van der Wulp, 1903, Biol. Centr.-Amer., Diptera, 2, p. 431 (Costa Rica: Río Sucio). Not of Linnaeus, 1758.

Ornithomyia pirangae Swenk, 1916, Jl. New York Ent. Soc., 24, p. 135 (no sex. Costa Rica: Juan Viñas, on *Piranga r. rubra.* Type ♀ in Dept.Entom., Univ.Nebraska, Lincoln). Muma, 1952, Bull. Univ. Nebraska State Mus., 3, pt. 3, p. 14 (type).

Ornithomyia strigilecula Ferris, 1923, Parasitology, 15, p. 57, figs. 3 and 14*A–C* (♀, larva; no host. Peru: Lima. Type in California Ac. Sci., San Francisco, mounted on 2 slides, No. 1473). Hennig, 1952, Larvenformen der Dipteren, 3, p. 402.

Ornithoctona strigilecula Ferris, 1924, Ent. News, 35, p. 234. Falcoz, 1930, Encyclop. Entom., Diptera, 5, (for 1929), p. 40 (Peru: Río Mixiolla, 1200 m., Prov. Huallaga. Colombia: on *Poecilothraupis igniventris lunulata* and *Conirostrum rufum.* Argentina: Villa Lutecia near San Ignacio, Misiones). Peters, 1936, Bird-Banding, 7, p. 25 (Maryland: on *Hedymeles ludovicianus*). J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., 3, No. 12, p. 415. Procter, 1946, Biol. Surv. Mt. Desert, 7, Insect Fauna, p. 437 (no specimen). Schuurmans Stekhoven, 1952, Beiträge zur Fauna Perus, 3, Wissenschaftl. Bearbeit., pp. 94 and 101.

"Louse-fly" Lugger, 1897, 2nd Ann. Rept. State Entom. Minnesota, (for 1896), p. 144, fig. 124 (Minnesota: on *Hedymeles ludovicianus*). Washburn, 1905, Univ. Minnesota, Agric. Expt. Sta., Bull. 93, p. 163, fig. 161.

Distribution and Specimens Examined. Dominion of Canada. Ontario: Narrows of Lake Abitibi, on *Wilsonia canadensis* (N.K. Bigelow); Lockton, on *Piranga erythromelas* (C. Hope); Ghost River, Lake Abitibi, June 27, on *Vireo philadelphicus* (N.K. Bigelow). — Quebec: Chelsea, on *Hedymeles ludovicianus,* May 27 (J. Fletcher).

United States. California: Marin Co.—Connecticut: without precise locality, on *Hedymeles ludovicianus* (S.W. Williston). — District of Columbia: Mt. Hamilton, on *Empidonax virescens* (P. Bartsch). — Illinois (recorded by MacArthur, 1948): Beach, Lake Co., on *Accipiter striatus velox* (W.W. Dearborn).—Kentucky (recorded by Wiedemann, 1830): Wiedemann's ♀ holotype, without more precise locality. — Maryland (recorded by H.S. Peters, 1936): Laurel, Prince Georges Co., on *Hedymeles ludovicianus,* May 14 (E.B. Marshall). — Massachusetts: Wellesley, Norfolk Co., May 20, 1902 (M.C.Z., from C.W. Johnson Coll.). — Michigan (recorded by MacArthur, 1948): East Lansing, Ingham Co., on *Hedymeles ludovicianus* (W.B. Barrows). — Minnesota (recorded by Lugger, 1897; MacArthur, 1948): without precise locality, on *Hedymeles ludovicianus,* June 23 (O. Lugger; specimen recorded by him in 1897, without name). — Nebraska: without

precise locality (M.C.Z., from Loew Coll.). — New Jersey: Mantua, Gloucester Co., on *Setophaga r. ruticilla,* July 4 (Carl L. Pedersen). — New York: without precise locality (J. Akhurst, in Osten Sacken Coll. at M.C.Z.); Ithaca, Tompkins Co., on *Dendroica tigrina,* May 18 (W. Montagna). — Pennsylvania: Reading, Berks Co., (L.S. Dillon). — Virginia: Falls Church, Fairfax Co., on *Dendroica tigrina* (N. Banks). — Washington (State): Pullman, Whitman Co., Oct. (L.R. Campbell). — Wisconsin (recorded by MacArthur, 1948): Milwaukee Co., on *Wilsonia canadensis,* May 20 (O.J. Gromme). — Also one specimen from the United States, without precise locality, on *Piranga erythromelas.*

Mexico (recorded by Rondani, 1878; Austen, 1903, as *O. varipes*): 8 kilom. E. of San Cristobal Las Casas, State of Chiapas, on *Junco phaeonotus fulvescens* (R.A. Paynter, Jr.); off the coast of Yucatan, on board ship, Apr. 25, 1952 (A.E. Holmes); Santa Rosa, Comitán, State of Chiapas, on *Piranga l. leucoptera* and *Momotus momota lessonii* (Esc.N.C.Biol.); Orizaba, State of Vera Cruz (A. Sallé).

Guatemala: Finca Samac, Alta Vera Paz (L.C. Stuart).

Costa Rica (recorded by van der Wulp, 1903, as *O. pilosula* and *O. avicularia;* Swenk, 1916, as *O. pirangae*): Juan Viñas, on *Piranga r. rubra* (type of *pirangae* Swenk. — L. Bruner); Río Sucio; Volcán de Irazú (type of *O. pilosula*).

Panama: Boquete, Chiriqui Prov., on *Pselliophorus tibialis,* with 2 Mallophaga attached; Barriles, W. of El Volcán, Chiriqui Prov., on *Cercomacra tyrannina rufiventris, Euetheia olivacea pusilla, Lipaugus h. holerythrus, Odontriorchis palliatus, Empidonax flavescens,* and *Henicorhina leucophrys collina* (Mrs. M.E. McClellan Davidson); Salta, Boquete, Chiriqui Prov., on *Turdus plebeius, T. tristis cnephosa,* and *Piranga bidentata sanguinolenta* (G.F. Ferris); Cerro Azul, Boquete, Chiriqui Prov., on *Atlapetes gutturalis.*

Antilles. Jamaica (recorded by Thompson, 1949): Newcastle Road, St. Andrew, 2000 ft., on *Seiurus a. aurocapillus* (G.B. Thompson); Hermitage, St. Andrew, 1800 ft., on *Mniotilta varia* (G.B. Thompson). — Hispaniola: Morne Tranchant, Haiti (J. Bend); Massif de la Selle, Haiti (A. Wetmore); Constanza, Rep. Dominicana, on *Dendroica pinus chrysoleuca* and *Zonotrichia capensis antillarum* (W.L. Abbott).

Colombia (recorded by Macquart, 1845, as *O. testacea;* Walker, 1849, as *O. varipes;* Speiser, 1902, as *O. parva;* Falcoz, 1930, as *O. strigilecula*): without precise locality (type of *O. varipes*); Meta

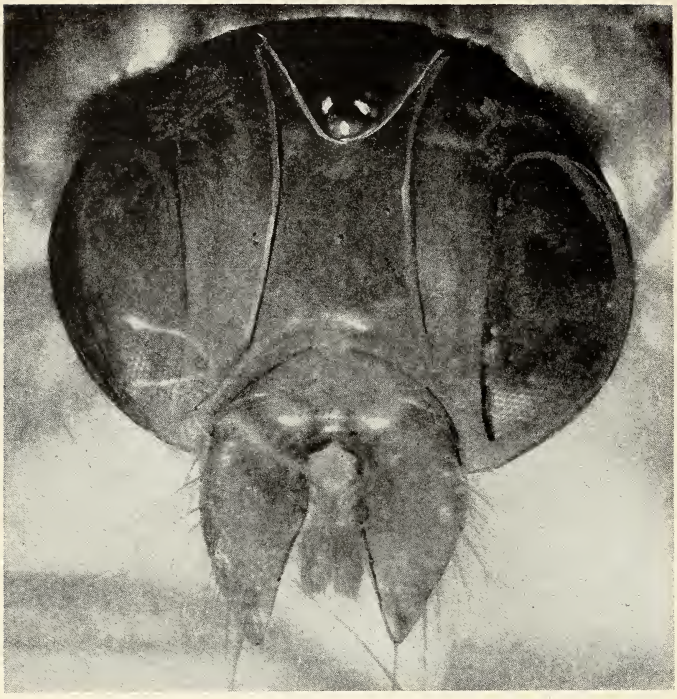

Fig. 40. *Ornithoctona fusciventris* (Wiedemann), head, ♀ holotype, Kentucky. Photograph by Mr. K. MacArthur (1948, fig. 239).

District (B. Guevara); Angostura, Dept. Santander Sur, on *Xanthoura yncas cyanodorsalis* (M.A. Carriker, Jr.); Piedecuesta, Dept. Santander Sur, on *Atlapetes schistaceus tamae, Cinnycerthia u. unirufa, Grallaria r. rufula, Dubusia t. taeniata, Zonotrichia capensis costaricensis, Synallaxis u. unirufa,* and *Turdus fuscater gigas* (M.A. Carriker, Jr.); Volador, Dept. Bolivar, on *Tachyphonus x. xanthopygius* (M.A. Carriker, Jr.); Palo Gordo, Dept. Santander Norte, on *Lepidocolaptes affinis lachrymiger, Tachyphonus rufus,* and *Platycichla flavipes leucops* (M.A. Carriker, Jr.); Buenos Aires, Dept. Santander Norte, on *Scytalopus sylvestris* (M.A. Carriker, Jr.); Vista Nieve, Sa. Marta, Dept. Magdalena, on *Chamaepetes goudotii sanctae-marthae* and *Scytalopus femoralis sanctae-martae* (M.A. Carriker, Jr.); Cincinnati, Sa. Marta, Dept. Magdalena, on *Momotus momota subrufescens* (M.A. Carriker, Jr.); Pamplona, Dept. Santander Norte, on *Poecilothraupis igniventris lunulata* (M.A. Carriker, Jr.); Virolin, Dept. Santander Norte, on

Fig. 41. *Ornithoctona fusciventris* (Wiedemann), head, ♀, Milwaukee Co., on *Wilsonia canadensis*. Photograph by Mr. K. MacArthur (1948, fig. 238).

Calospiza arthus aurulenta (M.A. Carriker, Jr.); Fusugasugá, Dept. Cundinamarca, on *Conirostrum rufum* and *Sturnella magna meridionalis* (Hno. Apolinar-María); Choachi, Dept. Cundinamarca, on *Poecilothraupis igniventris lunulata* (Hno. Apolinar-María); Usaquen, Dept. Cundinamarca (E. Osorno M.); Aguadita, on *Conirostrum rufum* (Hno. Apolinar-María).

Venezuela: Summit of Mt. Duida, Territory of Amazonas (Tyler Duida Exp.); Mt. Roraima, State of Bolivar (T.D. Carter); Camp Benitez, N. slope of Mt. Marahuaca, 4000–5000 ft., Territory of Amazonas (J. Maldonado C.).

Brazil (recorded by Bau, 1905, as *O. pilosula*): Rio de Janeiro (E.G. Holt); Vermelho, 30 Kilom. N. of Cara Pintada, on Rio das Marrecas, State of Paraná, on *Sclerurus s. scansor* and *Thamnophilus caerulescens gilvigaster* (Polish Zool. Exp.); near Cachoeira, State of Rio Grande do Sul (W.F. Henninger); São Paulo, State of São Paulo, on *Thamnophilus c. caerulescens;* Maromba, Itatiaia, State of São Paulo (J. Lima); Mogi dos Cruzes, State of São Paulo, on *Thamnophilus c. caerulescens;* Boraceia, State of São Paulo, on *Thamnophilus c. caerulescens;* Fazenda Bôa Esperanza, S. José da Lagoa, State of Minas Gerais, on *Colonia c. colonus.*

Ecuador: Baños-Mera trail, 1200 m., Dept. Tungurahua (J. Clarke-MacIntyre).

Peru (recorded by Austen, 1903, as *O. varipes;* Ferris, 1923, and Falcoz, 1930, as *O. strigilecula*): Chanchamayo, 1500–2000 m. (Strasbourg Mus.); Oreja de Capelo near Pan de Azucar, Río Tarma, on *Accipiter erythrocnemius ventralis* (W. Weyrauch): Pan de Azucar, Río Tarma, on *Zonotrichia capensis peruviensis* (W. Weyrauch); Maraynioc (or Marainioc), 20 miles N.E. of Tarma, on *Poecilothraupis l. lachrymosa* (J.A. Griswold, Jr.); Río Mixiollo, 1200 m., Prov. Huallaga (G.A. Baer); Hacienda Cadena, Marcapata, Cuzco, 1000 m., on *Thamnophilus melanchrous* and *Thlypopsis sordida chrysopis* (C. Kalinowski); Lima (R.H. Beck. — Holotype ♀ of *O. strigilecula*).

Argentina (recorded by Falcoz, 1930, as *O. strigilecula*): Tafi del Valle, 2300 m., Province Tucumán, on *Muscisaxicola fluviatilis* (R. Golbach); Villa Lutecia near San Ignacio, Misiones (Wagner).

Chile (recorded by Guérin-Méneville, 1844, as *O. chilensis*).

O. fusciventris is restricted to the New World, where its distribution parallels that of *O. erythrocephala.* The fewer records may be due in part to the small size and the preference for Passeriformes, on which flies are more difficult to collect than on pigeons and birds of prey. Nevertheless it appears to be more tropical, not extending as far north and south in the temperate areas, where it is perhaps a sporadic, casual summer visitor. The northmost records are from Chelsea, Quebec (45° 30′ N.), in the East and Pullman, Washington (46° 40′ N.), in the West; the southmost from northern Argentina (between 27° and 28° S.). Many gaps remain to be filled in the distribution. Of the 75 localities where *O. fusciventris* was taken, 4 are in southern Canada, 18 in the United States, 12 in Central America (Mexico to Panama), 5 in the Antilles, and 36 in continental South America. In the United States the records are scattered over the entire territory.

Known Nearctic Hosts of *O. fusciventris* (verified individual records in parentheses). Falconiformes (1): *Accipiter striatus velox* (1). Passeriformes (14): *Dendroica tigrina* (2); *Empidonax virescens* (1); *Hedymeles ludovicianus* (5); *Piranga erythromelas* (2); *Setophaga r. ruticilla* (1); *Vireo philadelphicus* (1); *Wilsonia canadensis* (2).

Known Neotropical Hosts of *O. fusciventris.* Falconiformes (1): *Accipiter erythrocnemius ventralis* (1). Galliformes (1): *Chamaepetes goudotii sanctae-marthae* (1). Coraciiformes (2): *Momotus momota lessonii* (1); *M. momota subrufescens* (1). Pas-

seriformes (49): *Atlapetes gutturalis* (1); *A. schistaceus tamae* (1); *Calospiza arthus aurulenta* (1); *Cercomacra tyrannina rufiventris* (1); *Cinnycerthia u. unirufa* (1); *Colonia c. colonus* (1); *Conirostrum rufum* (2); *Dendroica pinus chrysoleuca* (1); *Dubusia t. taeniata* (1); *Empidonax flavescens* (1); *Euetheia olivacea pusilla* (1); *Grallaria r. rufula* (1); *Henicorhina leucophrys collina* (1); *Junco phaeonotus fulvescens* (1); *Lepidocolaptes affinis lachrymiger* (1); *Lipaugus h. holerythrus* (1); *Mniotilta varia* (1); *Muscisaxicola fluviatilis* (1); *Odontriorchis palliatus* (1); *Piranga bidentata sanguinolenta* (1); *P. flava hepatica; P. l. leucoptera* (1); *P. r. rubra* (1); *Platycichla flavipes leucops* (1); *Poecilothraupis igniventris lunulata* (2); *P. l. lachrymosa* (1); *Pselliophorus tibialis* (1); *Sclerurus s. scansor* (1); *Scytalopus femoralis sanctae-martae* (1); *S. sylvestris* (1); *Seiurus a. aurocapillus* (1); *Sturnella magna meridionalis* (1); *Synallaxis u. unirufa* (1); *Tachyphonus rufus* (1); *T. x. xanthopygius* (1); *Thamnophilus c. caerulescens* (3); *T. caerulescens gilvigaster* (1); *T. melanchrous* (1); *Turdus fuscater gigas* (1); *T. plebeius* (1); *T. tristis cnephosa* (1); *Thlypopsis sordida chrysopis* (1); *Xanthoura yncas cyanodorsalis* (1); *Zonotrichia capensis antillarum* (1); *Z. capensis costaricensis* (1); *Z. capensis peruviensis* (1).

Bionomics. *O. fusciventris* will no doubt be recognized as one of the important bird-flies of the American tropics and subtropics. Although the 8 Nearctic and 46 Neotropical birds listed above can be only a fraction of the actual hosts, evidently the fly's true breeding hosts are Passeriformes (7 of the 8 Nearctic species, with 14 of 16 verified records; 43 of the 46 Neotropical species, with 49 of 53 verified records). The records are too fragmentary for detailed analysis, as few birds are represented by more than one capture; the fly may have a predilection for the Thraupidae (12 records from 11 species), a large, strictly American family of birds. *O. fusciventris* seems to replace *Ornithomyia fringillina* and *Ornithomyia parva* on Passeriformes in tropical America, perhaps owing to climatic factors rather than to interspecific competition. In temperate North America *O. fringillina* is known from 4 of the 8 species on which *fusciventris* was found. Moreover, the scarcity of North American records, in an area so well collected for hippoboscids, suggests that *fusciventris* is not truly indigenous there the year round. Most probably it is unable to survive through the winter in most of the Nearctic Region, either as adult flies on winter residents or as puparia; if so, it must be introduced afresh each spring on migratory birds returning from farther south.

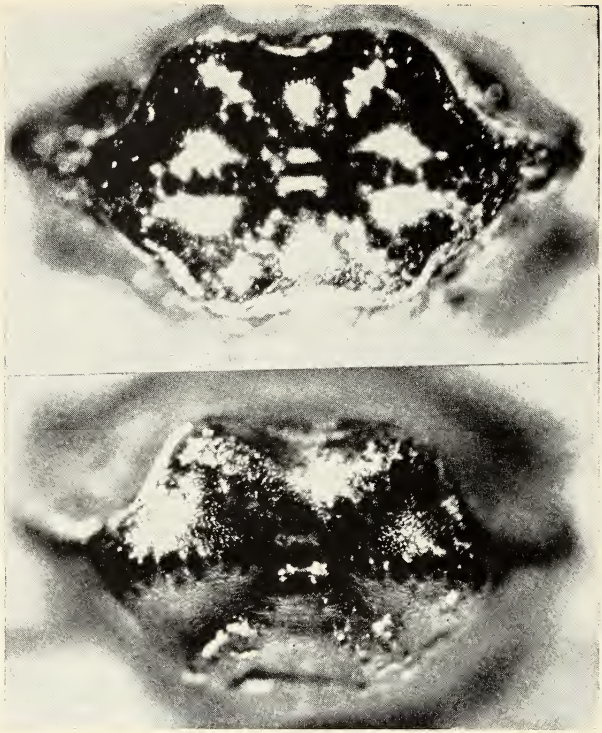

Fig. 42. *Ornithoctona fusciventris* (Wiedemann), 2 views of cap with respiratory lobes of puparium, Tafi del Valle. Photographs by Dr. W. L. Nutting.

Ferris described a larva of *O. fusciventris* deposited by a fly from Lima, Peru (1923, p. 58, fig. 4*B*, as *O. strigilecula*). I received from Dr. A. Willink a puparium deposited by a fly taken on *Muscisaxicola fluviatilis* at Tafi del Valle. This is entirely black, broadly elliptical in contour, somewhat depressed, equally convex dorsally and ventrally, 3.2 mm. long, 3 mm. wide, and 2.2 mm. thick. Two light longitudinal depressions, one dorsal and one ventral, run along each side margin, a short distance from the edge; the larval segmentation is superficially shown by 8 broad, shallow, transverse grooves, slightly interrupted medially and stopping at the lateral longitudinal depressions. A shallow notch encloses the small "buccal papilla" or cephalic segment anteriorly. Posteriorly, a large hexagonal cap, with rounded angles (Figs. 42), comprises the two polypneustic, spiracular lobes separated by a small but deep median pit; each lobe is divided by wide, shallow radiating depres-

sions in 3 broad, convex ridges, each bearing 12 to 15 irregularly placed pores on minute raised tubercles. The integument, devoid of setae or spines, is moderately shiny and microscopically alutaceous owing to a minute network of fine, close set engraved lines.

Additional information on the bionomics was included in Part I, pp. 156 (infestation with mites), 172 (phoresy of Mallophaga), and 321–322 (host relations).

Affinities. Among the species of *Ornithoctona* with long upper orbits, *O. fusciventris* is most closely related to the Indo-Pacific *O. australasiae* (Fabricius, 1805) (see J. Bequaert, 1941*b*, p. 269, for synonymy, from which *O. soror* Ferris, 1926, should be deleted, however) and the African *O. laticornis* (Macquart, 1835) (= *O. platycera* Macquart, 1843). These 3 species are about the same size and agree in the extent of the microtrichia in the wing. *O. australasiae* differs from the others in the relatively higher head, which is only about $1\frac{1}{4}$ times as wide as the height (from occipital margin to notch of frons) and in the antennal appendage being narrower throughout, with convex outer margin and nearly straight inner margin. In both *O. fusciventris* and *O. laticornis*, the head is about $1\frac{1}{3}$ times as wide as the height and the inner margin of the antennal appendage is distinctly convex; the only consistent difference between them appears to be that in *laticornis* the appendage ends in a longer and sharper point (about as in *oxycera*, but without the laterally compressed tip) than in *fusciventris*.

In *O. fusciventris* the venation is so variable (Figs. 39*B-C*) that few specimens have it exactly alike. The last section of the costa varies from about $\frac{1}{3}$ to slightly less than $\frac{2}{3}$ of the penultimate section. The position of the tip of the 1st longitudinal in relation to the anterior and anterior basal cross-veins, the distance between these two cross-veins on the 4th longitudinal, as well as the relative length of the 2nd basal and anal cells are also most unreliable; in some flies the anal cell is almost half the length of the 2nd basal, but in most it is decidedly less. The axillary cell shows sometimes a weak trace of an extra vein in the shape of a broad, linear convexity.

The 2nd antennal segment or appendage varies within even wider limits in *O. fusciventris* than in *O. erythrocephala*, as may be seen from the two extremes in the photographs of Figs. 40 and 41. One could easily be tempted to regard these two types as marking distinct species, if a series of flies did not show all gradations between them (Figs. 43*C-F*). It is, moreover, impossible to find other

reliable differences correlated with the two antennal types, although the more pointed antenna is more common.

As in most *Ornithoctona*, the lunula of *O. fusciventris* bears a more or less pronounced median depression or pit; anterior to this, the short, deep remnant of the suture dividing the 1st antennal segment from the lunula lies in a slight depression on either side of the narrow interantennal area; the depressions are sometimes deep enough to simulate a pair of pits. These pits are not a specific character.

Original description of *O. fusciventris* (German text translated): "Mellea; abdomine fusco, pedibus viridibus. Honey-yellow, with brown abdomen and green legs. Length $2\frac{1}{3}$ lines [Danish lines = 5.1 mm.]. Head and dorsum of thorax uniformly honey-yellow, with a reddish-yellow tinge, somewhat brownish on hind part of thorax; head anteriorly with a brown semi-lunar spot. Clypeus [frons] with a short angular emargination. Under side of head and thorax very pale yellow, the lip [gula] even white. Impressed cross-shaped line of notum distinct. Scutellum as in the European *O. avicularia:* flat apically, convexly raised basally. Abdomen brown, with 3 smooth transverse points [sclerites], basally with the usual transverse swelling or fold. Wings yellowish: veins brownish-black, their course exactly as in *avicularia.* Legs green; only outermost margins of femora and tibiae, as well as surface of hind femora, somewhat brownish." The ♀ type passed from Wiedemann to Winthem and later to the Vienna Natural History Museum. It was loaned to Mr. K. MacArthur, who sent it to me for study and who made the photograph of the head (Fig. 40). It agrees with the smaller of the two commonAmerican species of *Ornithoctona.* Wing 6 mm. long; total length of dry specimen about 5 mm., of combined head and thorax 3.2 mm.

Original description of *O. chilensis* Guérin (translated from the French): "Head and thorax fulvous-yellow, smooth, shiny. Abdomen ochre-yellow, very hirsute. Wings transparent; veins black near costa, yellow elsewhere. Legs testaceous; upper margin of fore and mid femora and all tibiae brown. Tarsi yellowish; tips of segments brown; claws black. Length $5\frac{1}{2}$ mm." As Speiser (1905) recognized, the size and figure refer it to *O. fusciventris,* even though this species has not been collected again in Chile. The following description by Macquart (1843) was based on the same specimen, now presumably lost, as he states that it was collected during the voyage of "La Coquille" and given to him by Guérin: "Picea. Pedibus flavis. Long. 2 l. [2 French lines = 4.5 mm.]. Pitch-brown. Legs yellowish." This description appeared before the text of Guérin's work, but after the Plate of the Atlas, which carries the specific name.

I have explained before why I use the name *Ornithomyia parva* Macquart (1843) for the common species of *Ornithomyia* of temperate South America, called *O. remota* by Walker (1849). I also mentioned the specimen from Colombia, labelled "*O. parva*" by Macquart and now in the Bigot Collection (in Mr. J.E. Collin's possession). Speiser (1902) recognized that this is an *Ornithoctona* and described it as follows (translated from the German): "Length as in the preceding species [*O. testacea* Macquart, the type of which is 4.5 mm. long]. Ground color umber-brown, with paler, more yellowish-brown humeral callosities and a more reddish-brown head. Frons [interocular face] relatively much wider, occupying half or more of width of head, narrowed anteriorly. Vertical triangle [postvertex] wider than long. Clypeus oris [frons] with only a median pit, which is, however, decidedly deeper than the 3 pits of the preceding species. Scutellum of the usual shape, with a median furrow showing

cross-wrinkles and widened posteriorly. Terminal section of costa only half as long as penultimate. Remainder as in preceding species [*O. testacea*]." My study of this specimen in 1951 has shown that it is a ♀ cospecific with *Ornithoctona fusciventris* (Wiedemann). The anterior ocellus is just on the level of the upper margins of the eyes and the wing is 6.5 mm. long.

Original description of *O. testacea* (French text translated): "Testacea. Abdomine griseo. Long. 2 l. [2 French lines = 4.5 mm.]. Head (including eyes) and thorax shiny testaceous. Abdomen grayish. Legs green; tarsi black. Wings somewhat yellowish." Speiser (1902) recognized it as an *Ornithoctona* and redescribed the type as follows (translated from the German): "Length 4.5 mm.; from oral margin to hind margin of scutellum, 3 mm. Head, thorax and legs almost uniformly testaceous; at most margins of antennal appendages darker and humeral callosities somewhat paler. Sculpture of clypeus oris [frons] very striking: it bears 3 small pits, one in the middle behind, and before this a symmetrical pair. Frons [interocular face] narrow, occupying only $\frac{1}{3}$ of width of head, exactly parallel-sided. Vertex [occipital margin] evenly rounded; vertical triangle [postvertex] wider than long. Thorax with fairly long and pointed humeral callosities, with a broadly interrupted transverse suture, otherwise without special features. Legs without special characters; fore tibiae without spur. Wings without peculiarities. Apical section of costa a little over half the length of penultimate; subcosta ending before small [anterior] cross-vein. Posterior [2nd] basal cell shorter than anterior [1st] basal cell for less than the length of the posterior [anterior basal] cross-vein; anal cell not quite half the length of posterior [2nd] basal cell." I also studied this type in 1951, reaching the conclusion that it is not separable from *O. fusciventris*, a common fly in Colombia. Antennal appendages about twice as long as wide (length to width, 50 : 23); anterior ocellus exactly on the level of upper margins of eyes; wing 6 mm. long, with a few microtrichia near tip; interocular face wider than eye (ratio, 27 : 19). The sex could not be determined in the present condition of the specimen.

Original description of *O. varipes:* "Fulva, verticis vitta antice picea, thorace bisulcato, abdomine piceo, pedibus fulvis, femoribus basi viridibus, tibiarum vittis tarsisque piceis, alis limpidis. Body dark tawny, smooth, shining; front of the head and mouth beset with bristles; crown with a broad dull stripe, whose fore border is pitchy: eyes pitchy: two indistinct furrows on the chest, one longitudinal, the other transverse quite obsolete at the point of intersection: abdomen pitchy, dull, clothed with black hairs: legs tawny, beset with black bristles; thighs at the base bright green; shanks with pitchy streaks; feet pitchy; claws black, long: wings colourless; wing-ribs pitchy; fore border veins black, the other veins dull tawny. Length of body 2 lines [4.3 mm.]; of the wings [span of wings] 5 lines [10.6 mm.]." Austen (1903) examined the type and thought that it might be an *Ornitheza*, a genus unknown at present in the New World. He also could not separate it from *Ornithomyia obscurata* Walker (1861), described from Celebes, and he referred to *varipes* the following specimens at the British Museum: van der Wulp's (1903) supposed *Ornithomyia avicularia*, from Río Sucio, Costa Rica, a ♀ from Huamachuca, Peru, a ♀ from Orizaba, Mexico, and a ♀ from Molokai, Hawaii. In 1951 I examined the type and the other specimens at the British Museum. The type I regard as a ♀ of *Ornithoctona fusciventris:* antennae large and leaf-like; venation as in *Ornithoctona* (not as in *Ornitheza*); interocular face twice as wide as an eye; anterior ocellus placed near the level of upper margins of eyes; the one remaining, incomplete wing measures 4.9 mm. to the tip of the 3rd longitudinal, giving 6.3 to 6.5 mm. for the complete wing. van der Wulp's specimen from Costa Rica, and the flies from Peru and Mexico are (as Austen stated) cospecific with *O. varipes*, hence also *Ornithoctona fusciventris*. The specimen from Molokai is an *Ornithoctona* and most probably also the American *O. fusciventris* (not *Ornitheza metallica* as I suggested in 1941*b*, p. 260); the palpi are unfor-

tunately destroyed, making the specific determination difficult. As for the type of *O. obscurata,* it is a ♀ of the Indo-Malayan and Pacific *Ornithoctona australasiae* (Fabricius), which is, moreover, closely related to *O. fusciventris,* as mentioned above.

Original description of *O. pilosula:* "♀ ? Head and thorax rufous; abdomen dark brown; legs yellowish, hairy; wings brownish-hyaline; first vein ending in the costa above the small cross-vein; 4th and 5th portions of the costa nearly of the same length. Length 5.5 mm. Agrees in most respects with the European *O. avicularia:* the front [interocular face] is broader than the eyes; the semilunular plate before the antennae [lunula] has a rather deep impression; the ocelli are distinct; the end of the auxiliary vein is close to that of the 1st vein; and the inferior basal (anal) cell is present and complete. It differs, however, in having longer and more numerous hairs on the femora and tibiae, the somewhat more elongate form, and also in the neuration: the 1st vein ends in the costa just above the small cross-vein, the latter being more retracted towards the base of the wing; the 4th portion of costa (between the 1st and 2nd veins) is as long as the 5th (between the 2nd and 3rd veins)." Austen published (1903) the following notes on the type: "This species closely resembles *O. varipes* Walker, in size and general appearance. The antennary processes, however, although large and lanceolate, are narrower than in that species, more elongate and more pointed at the tips. Their apical halves are somewhat divergent, and the species should probably be assigned to the genus *Ornitheza.* It is stated by van der Wulp that *O. pilosula* agrees in most respects with the European *O. avicularia;* but the shape of the antennary processes is entirely different. The figure of the head (v. d. Wulp's Pl. 13, fig. 6) is misleading, since it gives no idea of the orbital margins, which, like those of *O. varipes,* are greatly expanded posteriorly." Dr. F. van Emden wrote me (1951) that the type is a ♀, with a wing length of 6.78 mm. (5.37 mm. to tip of 3rd vein); antennae leaf-shaped, though somewhat narrower than in the type of *varipes;* ocelli well-developed, placed above a line drawn through upper margins of eyes; width of interocular face as in *varipes;* 2nd longitudinal vein free throughout from costa; section of costa between tips of 2nd and 3rd veins practically as long as preceding section, while in *varipes* it is only half as long. My personal study of the type in 1951 confirmed these observations. I consider *O. pilosula* as cospecific with the common *Ornithoctona fusciventris.* As shown before, the outline and relative width of the antennal appendage, as well as the relative length of the sections of the costa and other details of the venation, vary within specific limits in this, as in other species of *Ornithoctona.*

Original description of *O. pirangae:* "Length 4.5 mm. Head and thorax above shining brownish testaceous, clearing to yellowish testaceous on the lower orbital margins, vertex [postvertex], anterior margin and median line of mesonotum and base of scutellum. Orbital margins, broadening posteriorly and vertex [postvertex], polished, the median area [mediovertex] conspicuously duller and of subuniform width throughout. Clypeus [frons] anteriorly medially emarginate and bearing a small, shallowly rounded pit, most of its dorsal surface involved in a large, oval, deep pit. Antennary processes a little less than twice as long as broad, the outer margins strongly convex and the inner margins nearly straight, causing the pointed tips to appear divergent, in color fusco-testaceous and clothed with dark hairs. Eyes brown. Mesonotum with a slight median longitudinal depression and somewhat stronger transverse, slightly sinuate, median lateral depressions. Scutellum slightly convex and with a slight transverse depressed line near apex which bears 4 strong black bristles. Under side of head and thorax shining pale testaceous, the long spines on anterior coxae and the labium whitish. Legs greenish testaceous, paler beneath, the tarsi infuscated and the claws black. Abdomen yellowish, copiously but not densely clothed with short, black hairs. Wings clear, the costal veins and bases of the longitudinal veins black, the 1st longitudinal vein ending in the costa

above the 2nd [anterior basal] crossvein and considerably before the 1st [anterior] crossvein, the costal border of the marginal cell a little less than twice as long as the costal border of the 1st submarginal cell and the 1st basal cell as much longer than the 2nd basal cell as the length of the 2nd [anterior basal] crossvein. This species is apparently closest to *O. haitiensis* Bigot, with which it agrees in the dark hair on the antennary processes and the 1st longitudinal vein ending in the costa before the 1st [anterior] crossvein, but differs in its smaller size (*haitiensis* is 7 mm. long), in the form of the clypeus [frons] (*haitiensis* has a small dorsal pit, but a large and deep angular anterior pit) and in the coloration (*haitiensis* has a large, well-defined, cordiform mesonotal area, a black ocellar spot, etc.). It differs at once from *O. erythrocephala* Leach and *O. bellardiana* Rondani in the dark instead of ferruginous hairs on the antennal processes. Its small size separates it at once from the described North American forms except *O. butalis* (which has a very different coloration), *O. anchineuria* (which has the basal cells of subequal length) and *O. fusciventris* (which has the head and mesonotum uniformly colored).'' The type, examined at Lincoln in 1940 and again in 1953, is a ♀ agreeing in every respect with what is here called *Ornithoctona fusciventris*. The wing is 6 mm. long. It should be noted that the color of the setae on the antennal appendages, head and thorax is of no specific value in this genus.

Original description of *O. strigilecula:* ''Female. General color dark brown. Length 6 mm. Head distinctly broader than long; dorsal side destitute of setae except for a pair at the anterior margin of the orbits and a small orbital pair farther back; ventral side with a row of small setae paralleling the orbits and a cluster on a prominence at each side of the palpi; antennae noticeably large, about half as long as the head, flat, tapering to a point anteriorly and bordered by many slender setae; palpi slightly shorter than the antennae, bearing numerous small setae. Thorax with the humeral angles strongly produced and bearing several long black setae and several small, stout setae just before the wing; mesonotum destitute of setae except for one long one at the base of the wing and two widely separated long ones behind the wing; scutellum with a few very small marginal setae and a median cluster of 3 quite long setae. Ventral side with no setae except for a row in front of the middle coxae; mesosternum produced anteriorly into a pair of processes which surpass the anterior coxae. Legs with no especially distinctive characters except for the presence on the first segment of the hind tarsi of a distinct comb of small, stout setae. Wings of the type common to the genus, the setulae arranged in a definite pattern as shown, the posterior margin not ciliate. Abdomen with the basal tergite very short, beset medially with many small setae, these giving way laterally to long setae; the dorsum bearing 3 small, median, chitinized areas and thickly beset with small slender setae except for the apical area; apical area with a pair of small chitinized areas which bear 3 long setae. Basal sternite small, with a marginal series of small, stout setae; remainder of the venter thickly beset with setae of which those of the median region are small and slender and those of the marginal areas and about the vaginal opening are long and slender. Spiracles quite small.'' The author added that its most distinctive features, as compared with *O. lagopodis* (=*fringillina*) and *O. avicularia*, are the presence of the ventral comb on the hind basitarsi and the anterior prolongations of the mesosternum. He referred it later (1924) to *Ornithoctona*. From the description and figures it is easily recognized as *O. fusciventris*, and I confirmed this identity by studying the type slides at San Francisco in 1953.

Ornithoctona oxycera Falcoz

Figs. 39*D*, 43*I–K*, and 44 *E*

Ornithoctona oxycera Falcoz, 1930, Encyclop. Entom., B, Diptera, 5, (for 1929), p. 36, figs 1–3 (♀. Colombia: Bogotá, on *Buteo* [*Geranoaëtus*] *m.*

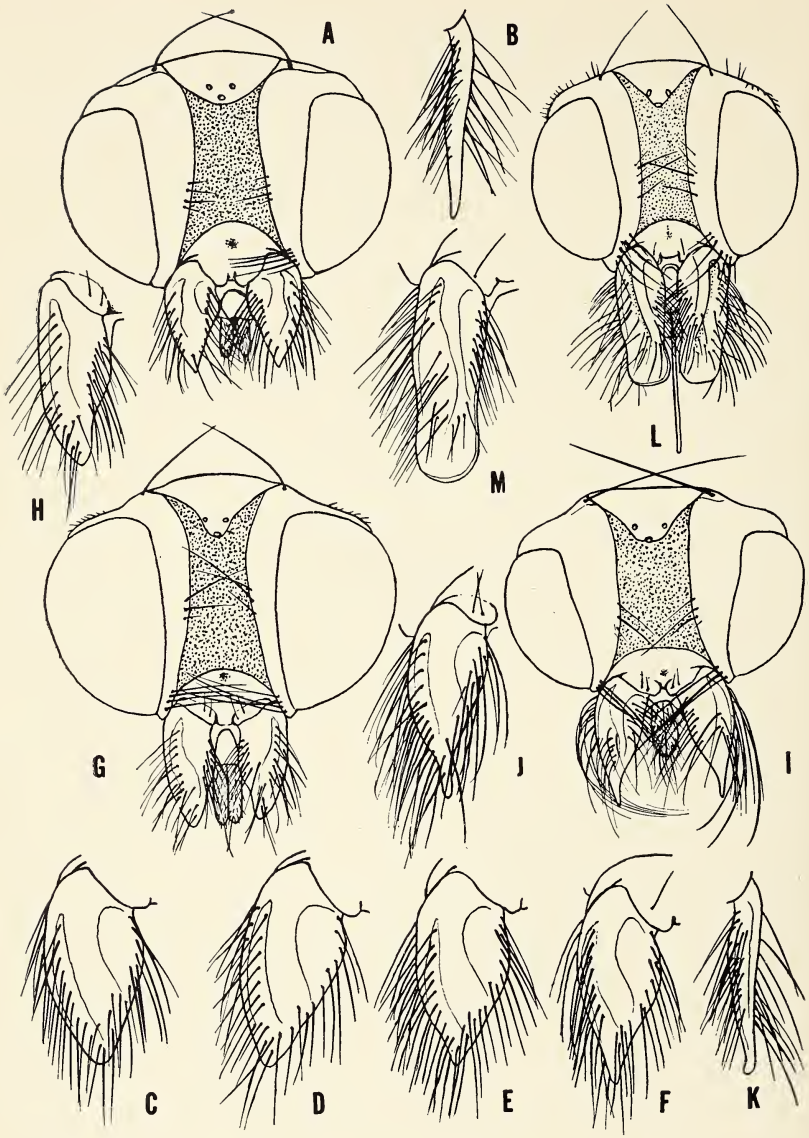

Fig. 43. **A–F**, *Ornithoctona fusciventris* (Wiedemann): **A**, head, ♀, Vermelho, on *Sclerurus s. scansor;* **B** and **F**, side and front views of antennal appendage (2nd segment), ♀, Boquete, on *Pselliophorus tibialis;* **C**, antennal appendage, ♀, Ghost River, on *Vireo philadelphicus;* **D**, same, ♀, Choachi, on *Poecilothraupis igniventris lunulata;* **E**, same, ♀, Falls Church, on *Dendroica tigrina.* **G–H**, *Ornithoctona orizabae* J. Bequaert, ♂ holotype, Orizaba; **G**, head; **H**, antennal appendage. **I–K**, *Ornithoctona oxycera* Falcoz: **I**, head, ♀, El Jonquito; **J**, front view of antennal appendage, ♂, Fusugasugá; **K**, side view of antennal appendage, ♀, El Jonquito. **L–M**, *Ornithoctona* (*Ornithopertha*) *nitens* (Bigot), ♀, Turrialba, on *Trogon* sp.: **L**, head; **M**, antennal appendage.

melanoleucus. Holotype in spirit at Paris Mus.; location of pinned paratype unknown). J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., 3, No. 12, p. 416; 1942, Bol. Entom. Venezolana, 1, pt. 4, p. 81. Anduze, Pifano and Vogelsang, 1947, *Op. cit.*, Num. Extra, p. 6.

Distribution and Specimens Examined. COLOMBIA (recorded by Falcoz, 1930): Valdivia, Dept. Antioquia, on *Myiodynastes c. chrysocephalus* (M.A. Carriker, Jr.); Chinchicúa, Sa. Marta, Dept. Magdalena, on *Dendroica striata* and *Turdus olivater sanctae-martae* (M.A. Carriker, Jr.); Fusugasugá, Dept. Cundinamarca, allotype ♂ (Hno. Apolinar-María); Muzo, Dept. Boyaca (Hno. Apolinar-María).

VENEZUELA: El Junquito, 2040 m., near Caracas (P. Anduze); Colonia Tovar, State of Aragua, on *Thraupis cyanocephala olivicyanea* (E. Mondolfi).

This rare Neotropical species is unusual for its restricted distribution, being known only from Colombia and Venezuela.

Known Neotropical Hosts of *O. oxycera* (verified individual records in parentheses): Falconiformes: *Buteo m. melanoleucus*. Passeriformes (4): *Dendroica striata* (1); *Myiodynastes c. chrysocephalus* (1); *Thraupis cyanocephala olivicyanea* (1); *Turdus olivater sanctae-martae* (1).

Bionomics. Nothing is known of the life history of *O. oxycera*. The 5 host records, from as many different species of birds, barely suggest that the only true breeding hosts are most probably Passeriformes.

Affinities. *O. oxycera* is closely related to *O. fusciventris,* from which it differs essentially only in the larger size (nearly 5 mm. in ♀ from tips of antennae to hind margin of scutellum, as compared with about 3.5 mm. for *fusciventris*), and in the antennal appendage being much more slender over the apical half (well beyond the range of variation of *fusciventris*) and distinctly flattened from the sides at the tip (Figs. 43*J-K*). The head (Fig. 43*I*) has the sides of the upper orbits more abruptly curved behind than in *fusciventris,* although this feature is exaggerated by Falcoz (1930, p. 37, fig. 1). His drawing of the ♀ abdomen (fig. 3) shows very small 2nd and 3rd median sclerites; but their absolute and relative sizes vary and I have seen some *oxycera* in which they differ scarcely from those of *fusciventris.* The prosternal lobes (Fig. 44*E*) are longer, straighter and more pointed than in most other *Ornithoctona,* though I have not seen them as slender and sharp as figured by Falcoz (fig. 2). The wing (Fig. 39*D*) is more extensively covered with microtrichia than in *fusciventris.* Falcoz noted that the apical zone of the basal

abdominal sternite bears crowded small spines; but these are only a little thicker and more spine-like than in other species and are in several irregular rows, not in a true comb.

The allotype of the *male*, here described for the first time, is from Fusugasugá, Colombia, without host (at Mus. Comp. Zool., Cambridge, Mass.). It differs little from the female, except for the usual, large, transverse, median sclerites on the dorsum of the abdomen, which are like those of *fusciventris*. The spine-like setae at the apex of the basal abdominal sternite are longer than in the ♀. The terminalia are similar to those of other *Ornithoctona*. Length from tips of antennae to hind margin of scutellum, 4.5 mm.; of wings, 9 mm.

Original description of *O. oxycera* (translated from the French): "Length, from base of antennae to apex of abdomen, 8 mm. Color uniformly reddish-brown; margins of antennal appendages black. Head $1\frac{1}{2}$ times as wide as long, antennae not included. Clypeus [frons] slightly convex and divided by a shallow longitudinal groove. Orbits widened posteriorly; orbital bristles poorly developed. Occipital triangle or ocellar area [postvertex] twice shorter than wide at base. Frons [mediovertex] a little longer than occipital triangle. Antennal appendages about in sagittal plane of body, lamelliform, twice as long as wide at base, abruptly narrowed at about the apical third, which is drawn out into a point flattened from the sides; dorsal surface with two longitudinal grooves separated by a broad median carina; margins provided with black setae, longer at outer border. Thorax markedly wider than long. Longitudinal suture [median notal suture] very fine; transverse suture evanescent medially. Humeral callosities long and pointed, bearing long setae. Mesothoracic [prothoracic] spiracles oval, very large. Mesopleural setae [on anepisternum] numerous, strong; 2 long preälar setae and 2 prescutellar setae on each side. Scutellum with a transverse groove near hind border, which bears 4 setae. Mesosternal protuberances [prosternal lobes] as in [the author's] fig. 2 [very long, slender and sharp]. Hind legs with a basal comb or ctenidium of black spinules on under side of first tarsal segment, as in some other species of the genus. Wings with dark veins; last section of costa a little shorter (for about $\frac{3}{4}$) than penultimate; subcosta ending in costa opposite anterior cross-vein; anterior [first] basal cell a little longer than posterior [second], which is twice as long as anal cell. The areas between cubital [3rd longitudinal] and discoidal [4th longitudinal] and between discoidal and posticalis [5th longitudinal] bear microscopic setulae. Abdomen rather densely covered with black setae, longer along sides and at apex. Dorsally: basal tergite very short, followed by 3 scuta [median sclerites], only the first well developed and rectangular, the others very small and poorly defined; posteriorly, near apex, 2 pregenital protuberances, each with 4 or 5 long setae. Ventrally: basal sternite narrow, rectangular, well sclerotized, bearing at hind margin a kind of ctenidium or not very regular row of small black spines. Behind basal sternite, ventral integument with distinct traces of segmentation, 5 sternites being indicated." I have not seen the types, but the description and figures are fully adequate for correct recognition. The author's suggestion that either *O. fusciventris* Wiedemann or *O. nebulosa* Say might have been his *oxycera*, has proved erroneous. Mr. Séguy informs me (*in litt.*, Nov. 1953) that only the holotype, preserved in spirit, is now at the Paris Museum; the pinned paratype is presumably lost.

Subgenus *Ornithopertha* Speiser, 1902

Ornithopertha Speiser, 1902, Zeitschr. Syst. Hym. Dipt., 2, p. 167 (monotypic for *Ornithomyia nitens* Bigot, 1885).

Antennal appendage about three times as long as its greatest width, the tip very broad and evenly rounded, the outer and inner margins parallel, the upper surface grooved lengthwise.

Speiser's original diagnosis was as follows (translated from the German): "Antennal appendages more than twice as long as wide and two-thirds of the length of the head. Scutellum appearing very slightly swollen, in any case uniformly convex and without median longitudinal depression. Legs, wings, abdomen and shape as in *Ornithoctona,* except for the strikingly aberrant head." I have omitted from my own definition the character taken from the scutellum, which is at best of specific value only. Some species of *Ornithoctona,* proper, lack all indication of a longitudinal depression. Moreover, Speiser himself later described the scutellum of his *Ornithopertha anthracina* (a synonym of *O. nitens* in my opinion) as having a fine median furrow over about three-fifths of the length.

Ornithoctona (*Ornithopertha*) *nitens* (Bigot)

Figs. 39*E*, 43*L–M*, and 44*A*

Ornithomyia nitens Bigot, 1885, Ann. Soc. Ent. France, (6), 5, p. 241 (no sex; no host. Panama. Types ♀ from the Bigot collection, now in the J.E. Collin collection at Newmarket, England).

Ornithopertha nitens Speiser, 1902, Zeitschr. Syst. Hym. Dipt., 2, p. 166 (types). Aldrich, 1902, Smithson. Misc. Coll., 46, No. 1444, p. 657. Speiser, 1904, Ann. Mus. Nat. Hungarici, 2, p. 393 (types); 1907, Ent. News, 18, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., 4, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, 7, p. 192 (copy of description). Bau, 1929, Zoolog. Anzeiger, 85, p. 10. J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., 3, No. 12, p. 416; 1942, Bol. Entom. Venezolana, 1, pt. 4, p. 81. Anduze, Pifano and Vogelsang, 1947, *Op. cit.*, Num. Extra, p. 6.

Ornithomyia geniculata Bigot, 1892, The Humming Bird, 2, p. 49 ("♀ ♂". Costa Rica: on *Pharomachrus mocino costaricensis.* Types ♀ from the Bigot collection, now in the J.E. Collin collection at Newmarket, England).

Ornithopertha geniculata Speiser, 1904, Ann. Mus. Nat. Hungarici, 2, p. 394 (types); 1907, Ent. News, 18, p. 103. Aldrich, 1907, Jl. New York Ent. Soc., 15, p. 6. Speiser, 1908, Zeitschr. Wiss. Insektenbiol., 4, p. 304. Bau, 1929, Zoolog. Anzeiger, 85, p. 10 (specimens without locality).

Ornithopertha anthracina Speiser, 1904, Ann. Mus. Nat. Hungarici, 2, p. 393 (no sex; no host. Honduras. Type in Vienna Mus.); 1907, Ent. News, 18, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., 4, p. 304. Bau, 1929, Zoolog. Anzeiger, 85, p. 10 (Venezuela).

Ornithomyia erythrocephala Howard, 1902, The Insect Book, Pl. 22, fig. 3[illegible] Not of Leach, 1817.

Distribution and Specimens Examined. Mexico: El Ocote, Ocozocoautla, 650 m., State of Chiapas, 1 ♀ on *Trogon m. massena* (Miguel Alvarez del Toro); Santa Rosa, Comitán, State of Chiapas, 3 ♀ on *Pharomachrus m. mocino, Oreopeleia m. montana* and *Trogon collaris puella* (Esc.N.C.Biol., México).

Republic of Honduras (recorded by Speiser, 1904, as *anthracina*): Portillo Grande, Dept. Yoro, 5000 ft., 1 ♀ on "quetzal," *Pharomachrus m. mocino* (R.E. Stadelman).

Nicaragua: San Ramón, 1 ♀ on *Phaethornis superciliosus longirostris.*

Costa Rica (recorded by Bigot, 1892, as *geniculata*): without precise locality, on *Pharomachrus mocino costaricensis* (A. Boucard. — 3 ♀ cotypes of *O. geniculata* Bigot), and without host, 1 ♀ (Univ. Minnesota) and 2 ♀ (José C. Zeledon. — Specimen at U.S.Nat.Mus. figured by Howard, 1902, as *Ornithomyia erythrocephala*); Volcán Turrialba, 1800 ft., 1 ♀ on *Trogon* sp. (Am.Mus.N.H.).

Panama (recorded by Bigot, 1885): without precise locality or host (4 ♀ cotypes of *O. nitens*); El Volcán, Chiriqui Prov., 1 ♀ on *Trogon* sp. (C.B. Worth); Barriles, a few miles W. of El Volcán, Chiriqui Prov., 1 ♀ on *Trogon collaris puella* and 1 ♀ on *Troglodytes musculus inquietus* (Mrs. M.E. McLellan Davidson).

Colombia: Sierra del Líbano, Santa Marta, 6000 ft., Depto. Magdalena, 2 ♀ (H.H. Smith); Chinchicúa, Santa Marta, Depto. Magdalena, 1 ♀ on *Trogon p. personatus* (M.A. Carriker, Jr.).

Venezuela (recorded by Bau, 1929, as *anthracina*): Mérida, 1 ♀ (S. Briceño).

O. nitens is strictly Neotropical, being known thus far from southern Mexico (Chiapas) to Colombia and Venezuela.

Known Neotropical Hosts of *O. nitens* (verified individual records in parentheses). Columbiformes (1): *Oreopeleia m. montana* (1). Apodiformes (1): *Phaethornis superciliosus longirostris* (1). Trogoniformes (9): *Pharomachrus m. mocino* (2); *P. mocino costaricensis* (1); *Trogon* sp. (2); *T. collaris puella* (2); *T. m. massena* (1); *T. p. personatus* (1). Passeriformes (1): *Troglodytes musculus inquietus* (1).

Bionomics. The recorded captures, though few, seem to be satisfactory evidence that trogons (Trogoniformes) are the true and possibly sole breeding hosts of *O. nitens.* Of the 12 verified records 9 are from trogons; the remaining 3, from a pigeon (*Oreopeleia*), a hummingbird (*Phaethornis*) and a wren (*Troglodytes*), are either accidental occurrences or perhaps unreliable.

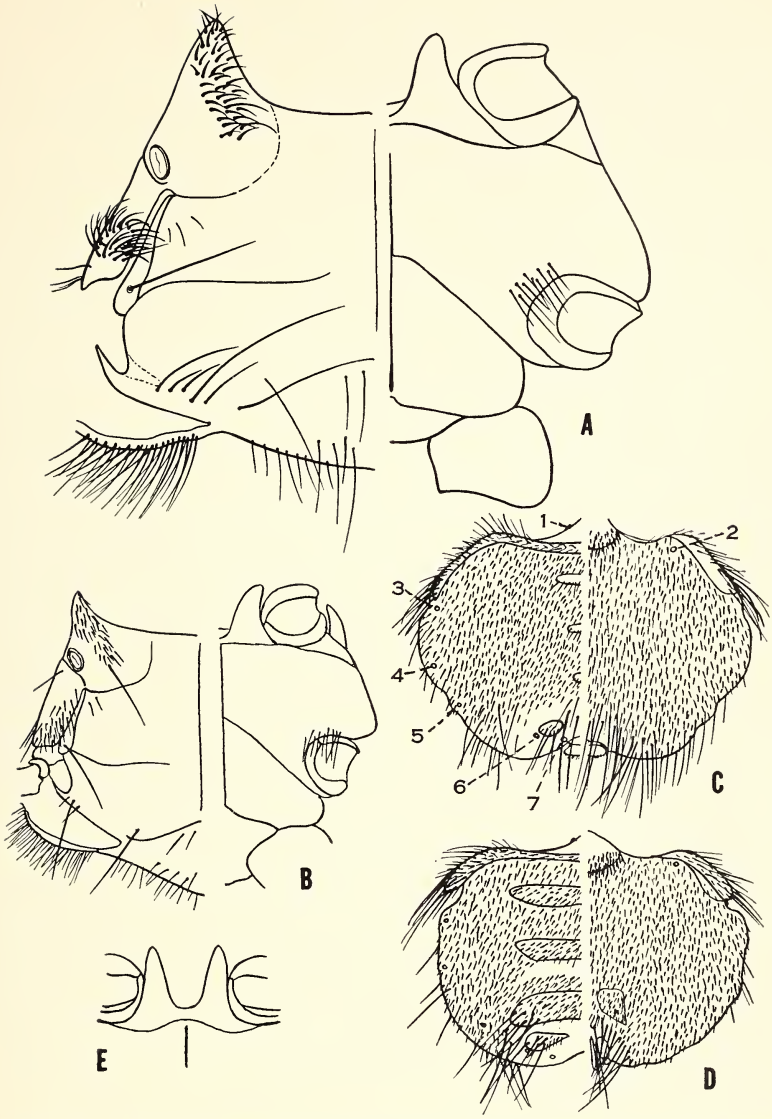

Fig. 44. **A**, *Ornithoctona* (*Ornithopertha*) *nitens* (Bigot), thorax dorsally and ventrally, ♀, Turrialba, on *Trogon* sp. **B**, *Ornithoctona orizabae* J. Bequaert, thorax dorsally and ventrally, ♂ holotype, Orizaba. **C**, *Ornithoctona fusciventris* (Wiedemann), abdomen dorsally and ventrally, ♀, New York; spiracles numbered 1 to 7. **D**, *Ornithoctona erythrocephala* (Leach), abdomen dorsally and ventrally, ♂, Orient, on *Accipiter striatus velox*. **E**, *Ornithoctona oxycera* Falcoz, prosternal lobes, ♀, Chinchicúa, on *Turdus olivater sanctaemartae*.

The puparium and other details of the life-history are unknown.

Affinities. *O. nitens* occupies an isolated position in the genus. The legs of the female I have seen from Turrialba, Costa Rica, were dull grass-green, showing that the haemolymph may contain green pigment, as in other species of *Ornithoctona.*

Speiser accepted 3 species of *Ornithopertha,* based on color differences; but I recognize only one. Although he had originally failed to distinguish the types of *geniculata* from those of *nitens,* he later attempted to separate these two forms as follows, while admitting that they might be only extremes of a "chain of variations" ("Variationsreihe"):

1. Sternum uniformly yellow or at least without well-defined dark nut-brown spots before the mid coxae ..... *O. geniculata*
   Sternum with a large, somewhat triangular dark nut-brown spot on each side between the fore and mid coxa ..... *O. nitens*

Speiser himself stated that, of Bigot's 4 cotypes of *nitens,* 3 had the sternal dark spots, while in the fourth the sternum was entirely yellow; on the other hand, of the 3 cotypes of *geniculata,* 2 had the sternum only very slightly darkened, but the third had it distinctly spotted. His *O. anthracina,* discussed later in detail, was based also chiefly on color, particularly on the brownish pitch-black head and thorax. A study of 23 specimens shows that these color differences are wholly unreliable, varying individually, the extremes being connected by transitions.

The male of *O. nitens* is as yet unknown. The cotype of *geniculata* which Bigot described as the male is a female, so far as could be determined.

In addition to the characters mentioned in the key, the species is remarkable in the genus *Ornithoctona* for its extreme hirsuteness, caused more by the unusual length and thickness of the setae than by their increased number. The bristles are particularly strong on the antennal appendages, under side of head, humeral callosities, anepisternum, axillary cord, tegula, and basal section of costa. There is only one notopleural bristle. The preäpical scutellar setae are very weak and few, 6 to 8 on each side placed in one irregular, transverse row and some longer than others; the base of the scutellum also bears a few weak setae. Three to 6 strong, but rather short vertical bristles form a group near each outer corner of the postvertex; but the orbital bristles at mid-height of the face are not more numerous than usual in *Ornithoctona* (3 or 4). Both dorsally and ventrally, the abdomen is mostly covered with very long, ap-

pressed setae, giving it a fuzzy appearance. On the legs also the setae are very long and thick, though not much more numerous than usual; they tend to form tufts near the tips of the femora. The transverse comb of stiff setae on the under side of the hind basitarsus is strikingly developed. The setae near the apical margin of the basal abdominal sternite, on the other hand, are few and very weak, hair-like.

Original description of *O. nitens* (French text translated): "Long, 9 mm. Nitida. Antennis nigris nigroque villosis; palpis flavidis; fronte testacea; oculis nigris; thorace nigro, linea media angusta, fulvida, humeris late, scutello, testaceis; abdomine nigro fusco, breviter et parce piloso; pedibus flavide lividis, geniculis, linea tibiarum laterali angusta, tarsis, omnino, fuscis; alis pallide fuscanis, venis, costali, longitudinalibus, 1–4is omnino, nigris, 5a et 6a, parum ultra transversas, ejusdem coloris, istis in medio pallidis.—Very shiny. Antennae testaceous, with black hairs; palpi yellowish; eyes black; frons [interocular face] yellowish; ocelliferous spot [postvertex] black; thorax yellowish, the dorsum broadly black, with a very narrow, reddish median line; humeral callosities broadly and scutellum testaceous, the latter with several blackish setae in the middle; sternum testaceous, with two large, blackish lateral spots; abdomen pale brown or yellowish, with scattered black hairs; legs pale yellowish, with knees, tarsi and a narrow margin along outer face of hind tibiae blackish; wings russet, veins brownish; costa, 1st to 4th longitudinals entirely, and 5th and 6th longitudinals to a little beyond 1st cross-vein, black, all of the same black color, the 2nd cross-vein brown; 1st longitudinal ending in costa about opposite the 1st (or outer) cross-vein, 2nd ending opposite 2nd cross-vein, and 3rd ending rather close to tip of 4th longitudinal; 2 basal cells fairly unequal." The five specimens mentioned by Bigot are now the property of Mr. J.E. Collin, in whose collection I have recently (1951) studied them. As Speiser (1902) recognized, four of them are cotypes of *nitens* and the fifth is a male of *Ornithoctona erythrocephala* (Leach) (=*haitiensis* Bigot). Speiser added the following information on the structural characters: "Vertex evenly rounded; postvertex wider than long; interocular face ["Stirn"] parallel-sided, with a dull median field [mediovertex] which widens somewhat anteriorly beyond midlength. Clypeus [interantennal frons] very short, with a symmetrical pair of notches at anterior margin. Antennal appendages long and not pointed as in the other species of *Ornithoctona*, but ending very broadly and bluntly. Thorax with a fine longitudinal line [median notal suture] and a transverse [mesonotal] suture blurred in the center; scutellum shaped as described in the generic diagnosis of *Ornithopertha*. The color is given correctly by Bigot. The fore legs lack the plate-like apical spine of the tibiae, present in the related Indo-Australian species [*Ornithoctona plicata* (v. Olfers)]. Shape and venation of wings do not differ essentially from those of *Ornithoctona*. The 1st longitudinal vein ["Subcostalis"] ends either before or just opposite anterior cross-vein ["kleine Querader"]; the 2nd longitudinal ["Radialis"] ends so close to 3rd ["Cubitalis"], that the last section of costa is only half as long as the penultimate. The 2nd basal cell ["hintere Basalzelle"] is shorter than 1st ["vordere Basalzelle"] only to the extent of the length of anterior basal cross-vein ["hintere Querader"]; it is much wider than the 1st, the anterior basal cross-vein being a little over twice the length of anterior cross-vein. Anal cell less than half the length of 2nd basal cell. Alula ["Anallappen"] of the wing distinct." Speiser's diagnosis of his genus *Ornithopertha* states also that the scutellum appears to be very slightly swollen, at any rate evenly convex, and without longitudinal median depression. All four cotypes of *O. nitens* appear to be females.

Original description of *O. geniculata* (French text translated): "Long. ♂ 9, ♀ 10 mm. ♂ Haustello palpisque fulvis, antennis, ejusdem coloris, nigro setosis, oculis fulvis, late nigro notatis, capite fulvo, facie utrinque carinata, tergo nigro nitido, antice, utrinque, macula lata, quadrata flava, lineaque angusta fulva, mediana, pictis; scutello flavido, nigro setoso; pectore flavido; abdomine obscure-fusco sat dense nigro velutino: pedibus pallide fulvis, nigro parce setosis, geniculis nigris; alis pallidissime fulvidis, venis nigris, transversa interna pallida. ♀ Paulo majore, abdomine, latiore, bilobato, oculis omnino fulvis, scutello fusco nigro, et nigro setoso.—♂ Proboscis and palpi fulvous; antennae fulvous with black setae; head fulvous; face with two strong lateral and longitudinal carinae; eyes fulvous with a large and long black spot; dorsum shiny, black anteriorly; on each side a large yellowish quadrangular spot and in the middle a fine, median, longitudinal yellowish line; scutellum yellowish, with scattered black setae; pleura and sternum fulvous; abdomen blackish-brown, covered rather densely with very short brown hairs; legs pale fulvous-yellow, with some sparsely scattered black setae; knees black; tarsi at their apices with many short, black setae; wings very pale brownish; veins blackish, except inner crossvein which is pale yellowish-white.—♀ Size somewhat larger; abdomen broad, bilobed; eyes uniformly fulvous; scutellum shiny black." All 3 cotypes, which I have recently (1951) studied in Mr. J.E. Collin's collection, appear to be ♀, not 2 ♂ and 1 ♀ as Bigot thought. Speiser (1902*b*, p. 167) at first did not recognize them as the types of *geniculata*, since he listed them as additional specimens of *O. nitens*, although one bears Bigot's original label "*geniculata*", as well as the mention of the host. When his attention was later called to the fact, Speiser attempted to separate *geniculata* as a distinct species, on the basis of certain color differences (1904*d*, p. 394); but, as shown above, these are unreliable. A most careful comparison has failed to disclose structural differences between the cotypes of *nitens* and those of *geniculata*.

Original description of *O. anthracina* (translated from the German): "Length, 9.5 mm.; from oral margin to hind margin of scutellum, 4.75 mm. General color shiny, somewhat brownish pitch-black; only head beneath pale, almost whitish yellow, and anterior or upper surface of tibiae paler in the middle than the edges, brownish-yellow; tips of antennal appendages also translucent brown. Structure of head not differing from that of *O. nitens* Big.; postvertex insignificantly narrower in proportion to its length and median dull area of vertex [mediovertex] even less widened anteriorly than in that species. Prescutum and scutum of mesothorax, as well as sternum, without peculiarities beyond the different color; but scutellum with a fine median furrow, extending behind over only about $\frac{2}{5}$ of the length, where it stops. Abdomen and legs showing nothing special. Wings darker than in *O. nitens*, umber-brown; venation exactly as in that species." I have not seen the type of *anthracina;* but, except for the presence of the fine furrow over part of the scutellum, the description mentions only color differences, which I cannot regard as reliable for specific distinction. Of two ♀ taken together in the Sierra del Líbano, Colombia, one has head and thorax almost entirely black, as Speiser described for his *anthracina;* while the other has the whole of head and thorax very extensively yellowish-brown; yet no structural difference could be detected. I can only consider *anthracina* as a synonym of *nitens*.

(*To be continued in vol. XXXV*)

ENTOMOLOGICA AMERICANA

A JOURNAL OF ENTOMOLOGY.

Volume XXXV (New Series)
for 1955

PUBLISHED BY THE
BROOKLYN ENTOMOLOGICAL SOCIETY
1955

ENTOMOLOGICA AMERICANA

Vol. XXXV (N. S.), for 1955

CONTENTS

VOL. XXXV (New Series)

ENTOMOLOGICA AMERICANA

A JOURNAL OF ENTOMOLOGY.

PUBLISHED BY THE

BROOKLYN ENTOMOLOGICAL SOCIETY

Published for the Society by the
Business Press Inc.
N. Queen St. and McGovern Ave., Lancaster, Pa.
Subscription, $5.00 per year
Date of issue, December 28, 1955

ENTOMOLOGICA AMERICANA

VOLUME XXXV

THE HIPPOBOSCIDAE OR LOUSE-FLIES (DIPTERA) OF MAMMALS AND BIRDS PART II. TAXONOMY, EVOLUTION AND REVISION OF AMERICAN GENERA AND SPECIES

BY JOSEPH C. BEQUAERT

ALEXANDER AGASSIZ PROFESSOR OF ZOOLOGY
MUSEUM OF COMPARATIVE ZOOLOGY AT HARVARD COLLEGE,
CAMBRIDGE, MASSACHUSETTS

(*Continued from volume XXXIV*)

CONTENTS

Stilbometopa Coquillett, 1899

Stilbometopa Coquillett, 1899, Canad. Entom., **31**, p. 336 (monotypic for *Ornithomyia fulvifrons* Walker, 1849).

Stilbametopa Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 193 (error for *Stilbometopa,* in the combination *Stilbametopa impressa*).

Stilpometopa Guimarães, 1944, Papeis Avulsos Depto. Zool. São Paulo, **4**, No. 5, p. 82 (error for *Stilbometopa,* in the combination *Stilpometopa ramphastonis*).

Stribbometopa Lizerand, 1953, Maladies du Gibier à Plumes (Paris), p. 94 (error for *Stilbometopa,* in the combination *Stribbometopa podopostyla*).

Generic Characters. Permanently and fully winged parasites of birds, not metallic-greenish, but sometimes with dull-green pigment in the haemolymph. Head large, transversely elliptical, inserted in the deeply concave anterior margin of prescutum. Ocelli absent. Eyes large, with minute, ill-defined facets. Postvertex larger than usual, smooth, sometimes anteriorly with a superficial pit or notch; occipital margin overlapping anterior margin of prescutum, with a distinct median, inward curve and separated from the long upper orbits by shallow sinuosities; mediovertex relatively short and narrow, as long as or slightly shorter than postvertex; inner orbits very broad. Frons (Fig. 47*D*) divided by a transverse suture into a broad upper lunula and a narrow interantennal portion; lunula as long as postvertex, with a median longitudinal impressed line ending in a pit at the ptilinal suture; interantennal portion divided almost to the base into two long, parallel, flattened arms, placed close together, slanting under the inner margins of the antennae, the apical tips broadly rounded and slightly diverging; integument of apical arms thick and hardened over basal half only, remainder (partly covered by antennae) thin, weakly sclerotized, flexible and translucent. Palpi short, extending little or not beyond antennal appendages. Antenna: 1st segment divided superficially or incompletely by a depression or fine suture from the side of lunula; appendage of 2nd long, broad, flattened, leaf-like, narrowed into a point; arista racket-shaped, the stalk abruptly widened at apex into a thin, elliptical plate, supported by a median thickening or rod giving off a few side riblets to the margins, the plate appearing pennate. Pronotum very short, not visible from above. Humeral callosity large, separated from anepisternum by an incomplete, superficial or rudimentary suture, extended forward as a long, bluntly triangular lobe; posthumeral suture deep over lateral third of prescutum, then superficial or obsolete toward anterior margin; prothoracic spiracle large, dorsal, placed far from side margin and from posthumeral sutures. Deeply concave an-

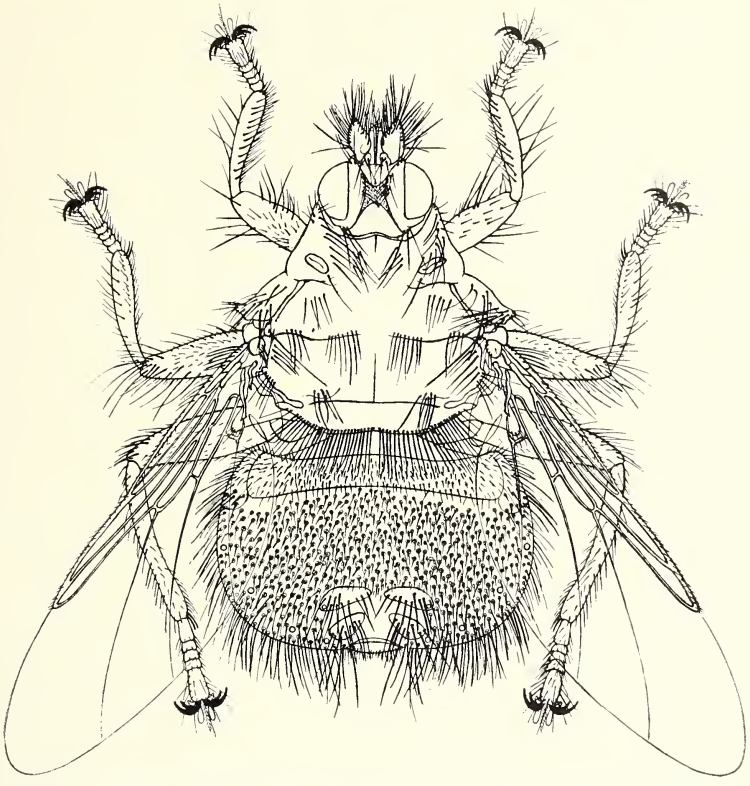

Fig. 45. *Stilbometopa impressa* (Bigot), ♀, Bitterwater, on *Lophortyx c. californica.* × about 8.

terior margin of prescutum slightly convex medially and somewhat raised to fit the inward curve of occipital margin; transverse mesonotal suture slightly behind mid-length of mesonotum, deep and nearly straight or slightly wavy laterally, broadly interrupted medially; anterior ridge of parascutellum fused with mesoscutum; median notal suture a superficial, very fine impressed line, often incomplete or mostly vestigial; notopleuron very narrow, as a rule divided from prescutum only anteriorly and fused with it posteriorly, but sometimes separated completely by a suture. Dorsal anepisternum broad, nearly parallel-sided, its outer, preälar edge more or less produced, the shape of the edge characteristic for each species. Scutellum broad, short, transversely semi-elliptical; hind margin with a sharp edge, straight or with a very slight median, inward curve and evenly rounded at the slanting sides; surface flat,

with a slight median, longitudinal depression triangularly widened behind; scuto-scutellar suture deep, continuous, straight or slightly wavy. Metathoracic pleurotergite prominent, moderately swollen basally, apically with a strong, anvil-shaped process. Sternum: pro-mesonotal suture indistinct or lacking; prosternum forming two broad, triangular, rounded or bluntly pointed, flattened intercoxal lobes separated by a wide notch continued behind as a deep median pit; mesosternum raised on each side as a blunt, transverse ridge before mid coxa, forming a low tubercle in *S. ramphastonis* and *S. legtersi;* meso-metasternal suture fairly distinct or weak, broadly V-shaped (with blunt forward angle ending in a furcal pit); basisternum and furcasternum of metathorax fused, their limit marked only by a deep, wide, median furcal depression; meta-basisternum produced behind on each side as a flat, retrograde tooth (*metasternal spur*) which overlaps the base of hind coxa. Metathoracic spiracle placed as in *Ornithoctona.* Legs long, robust; femora much swollen; tibiae broad, flattened; tarsal segments 1 to 4 very broad and short; hind basitarsus moderately lengthened, without transverse comb of setae beneath; tips of all tibiae normal; 2 apical spurs on all tibiae, often hidden in the adjoining bristles. Claw proper (Fig. 47*G*) deeply bifid, the two teeth nearly the same width, but the outer one longer and sharper; basal "heel" sharp, shorter than inner tooth. Wing large, with the complete venation for the family (Figs. 46*A–E*): 3 cross-veins, placed much as in *Ornithoctona;* subcosta complete, ending in costa close to tip of 1st longitudinal; axillary cell with a rudimentary axillary vein; 6th longitudinal broken up along hind margin of anal cell (Fig. 47*C*): basal portion thickened, ending abruptly and with a sharp inner edge connected with a lightly sclerotized area of the cell membrane, apical portion very narrow, pale, ending in a point; costa setulose; other veins bare; membrane bare throughout; alula very large; both calypteres much reduced, rudimentary. Abdomen: dorsally, behind the more or less fused basal pleurotergites, with 2 pairs of preänal sclerites in both sexes; median dorsal area without sclerites, membranous, not striate; ventrally, ♂ with a pair of flattened sclerites basad of terminalia and ♀ with a pair of elongate pregenital sclerites. Seven pairs of abdominal spiracles: 1st in side edge of the very short 1st pleurotergite; 2nd ventrally, some distance from sides of 2nd pleurotergite; 3rd to 7th latero-dorsally (on expanded abdomen), the 6th in or close to outer edge of 1st preänal sclerite, the 7th close to outer edge of 2nd preänal sclerite and some distance from anal opening. Integument of the very depressed head and thorax unusually smooth

and slippery, shiny, mostly bare; most setae reclining backward, except on antennae. On head and thorax some setae strong and black, others weak and pale; orbital bristles few, mostly in one irregular row, widely separated from a few bristles placed near lower frontal suture; antennal appendage, oral margin beneath and postgenae with long setae; 1 to 4 vertical bristles on each side near postvertex; disk of mesonotum bare except for small patches or short rows of long, appressed setae; 1 to 3 notopleural bristles; humeral callosity and anepisternum moderately setulose; disk of scutellum bare, but hind edge with a conspicuous, regular, dense, comb-like row of 40 to 46 long, stiff, recumbent bristles (the nearest approach to a ctenidium in the Hippoboscidae); metathoracic pleurotergal process with some short setae at both tips; no hypopleural bristles. Abdomen densely and fairly uniformly covered with short setae on small knobs; a few longer bristles apically and on tergal sclerites. Male terminalia (Fig. 47*E*) of the simplest type found in Hippoboscidae, reduced to aedeagus (penis and 2 penis valves); no trace of gonocoxites.

Stilbometopa possesses several unusual features, such as the peculiar interantennal frons, the trisinuate occipital margin, the extreme dorsal position of the prothoracic spiracles, the transverse scutellum with the conspicuous apical comb of bristles, the anvil-shaped metathoracic pleurotergites, the prominent metasternal spurs, the interrupted lower margin of the anal cell, the racket-shaped antennal arista, and the lack of gonocoxites in the male terminalia. The partial disappearance of the suture between notopleuron and prescutum in most species and the fusion of some of the sternal areas of the thorax in this genus help to understand the more complete loss of the thoracic sutures in some other Hippoboscidae.

Stilbometopa is a strictly American and mainly tropical and subtropical genus of 5 closely related species.The characters separating them are of degree only and often difficult to appreciate, so that the species are far from being completely elucidated. Of the 3 reported from temperate North America one (*S. impressa*) is known only from the western United States, another (*S. podopostyla*) perhaps occurs there only during the summer, and the third (*S. fulvifrons*) is clearly accidental.

The subjoined key supersedes one published some years ago (J. Bequaert, 1935*b*, pp. 323–324), which used other characters now regarded as either unreliable or too subtle for ready identification, as discussed under the several species. In particular, I have found

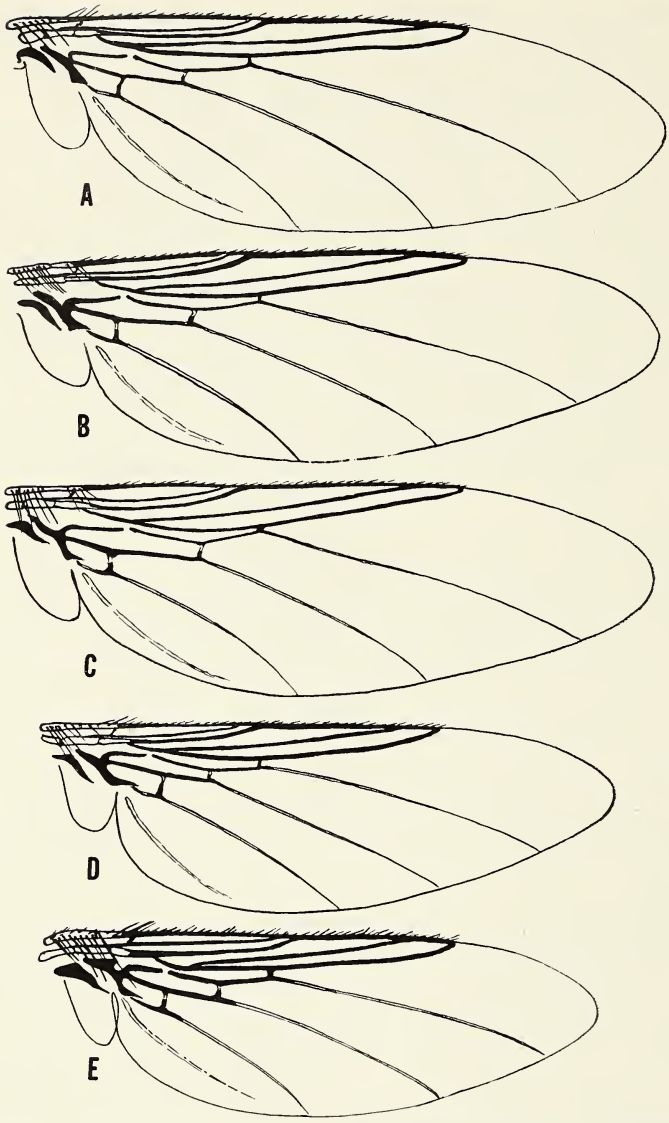

Fig. 46. Wings of *Stilbometopa:* **A**, *S. impressa* (Bigot), ♂, Bitterwater, on *Lophortyx c. californica;* **B**, *S. podopostyla* Speiser, ♀, Nova Teutonia, on *Tinamus solitarius;* **C**, *S. fulvifrons* (Walker), ♀, Baraguá; **D**, *S. ramphastonis* Ferris, ♀, Sto Thomas, Izabal, on *Ramphastos* sp.; **E**, *S. legtersi* J. Bequaert, ♀ holotype, Xocempich.

the shape of the metathoracic pleurotergal process too variable intraspecifically to be trusted; it depends also to some extent upon the angle at which it is viewed. The number of vertical bristles likewise is not reliable as a specific character.

Key to Species of *Stilbometopa*

1. Preälar apex of anepisternum seen from above broad and protuberant, obliquely truncate, with a prominent, blunt outer and a small inner angle (Fig. 50*F*). Metasternal spur reaching nearly mid-length of hind coxa. Inward curve of occipital margin broad and very shallow (Fig. 47*F*). Wing 8 to 9 mm. long ..... *S. impressa*

   Preälar apex of anepisternum seen from above narrow, rounded off, not with a prominent outer angle 2

2. Preälar apex of anepisternum seen from above gradually narrowed into a blunt angle, not lobe-like nor set off by a depression (Figs. 50*I–J*). Notopleuron completely divided by a suture from prescutum. Metasternal spur reaching mid-length of hind coxae 3

   Preälar apex of anepisternum seen from above somewhat projecting, either lobe-like or set off by a slight depression (Figs. 50*G–H*). Notopleuron only partially divided by a suture from prescutum, fused with it posteriorly 4

3. Basal sternite of abdomen short, wider than long, with a few short setae at apical margin; basal tergite short, not deeply curved inward nor divided medially. Inward curve of occipital margin broad and very shallow (Fig. 49*C*). Wing 8.5 to 9 mm. long ..... *S. ramphastonis*

   Basal sternite of abdomen longer than wide (somewhat shorter in ♂ than in ♀), bare; basal tergite long, deeply curved inward and divided to near base medially. Inward curve of occipital margin broad, but deep (Fig. 49*D*). Wing 6.5 to 7.5 mm. long ..... *S. legtersi*

4. Metasternal spur short, not reaching mid-length of hind coxa (Fig. 48*A*). Preälar apex of anepisternum relatively narrow, slightly curved inward at the depressed and somewhat lobe-like tip (Fig. 50*G*). Inward curve of occipital margin deep and narrow (Fig. 49*A*). Wing 6.5 to 8 mm. long. *S. podopostyla*

   Metasternal spur long, reaching mid-length of hind coxa (Fig. 48*C*). Preälar apex of anepisternum relatively broad, evenly rounded off, not lobe-like (Fig. 50*H*). Inward curve

of occipital margin moderately deep and wide (Fig. 49*B*). Wing 6.5 to 8 mm. long ..... *S. fulvifrons*

Stilbometopa impressa (Bigot)

Figs. 45, 46*A*, 47*A–G*, and 50*B–F*

Olfersia impressa Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 237 (no sex; no host. California. Type ♂ from Bigot Coll., now in J.E. Collin Coll.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 191 (copy of original description).

Stilbometopa impressa Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 163 (type; also another specimen from California). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303. Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 201, figs. 17 and 18*A–C* (♀. California: Mecca; Mt. Hamilton, on quail; San Diego; and without precise locality, on *Lophortyx c. californica*). Essig, 1926, Insects Western North America, p. 623. Falcoz, 1930, Encycl. Entom., Ser. B, Diptera, **5**, (for 1929), p. 27 (♀. Arizona). Ferris, 1930, Canad. Entom., **62**, p. 64, figs. 2*E* and 2*G* (fig. 2*E* referred to *S. ramphastonis* by error in caption, corrected in text. Arizona: Rincon Mts., on *Lophortyx g. gambelii*). O'Roke, 1930, Univ. California Publ. Zool., **36**, pt. 1, p. 12; 1932, California Fish Game, **18**, pt. 3, p. 230. Gorsuch, 1934, University of Arizona Bull., **5**, pt. 4, p. 56 (Arizona: on *Lophortyx g. gambelii*). J. Bequaert, 1935, Rev. de Entomologia, **5**, pp. 323 and 325, fig. 1*A*. Herman and Glading, 1942, California Fish Game, **28**, p. 150, fig. 45 (larger of 2 flies shown). Herman, 1944, Jl. of Parasitology, **30**, pp. 112–118 (California: Orange Co.; Riverside Co.; San Benito Co.; O'Neals, Madera Co., on *Lophortyx c. californica*. Life history; puparium); 1945, California Fish Game, **31**, p. 21, figs. 10*A* and 10*C* (puparium, adult). Herman and Bischoff, 1949, *Op. cit.*, **35**, p. 295 (California: Dune Lakes area, San Luis Obispo Co., on *Lophortyx c. californica*. Transmission experiments with *Haemoproteus lophortyx*). Herms, 1950, Medical Entomology, 4th Ed., p. 414. Tarshis, 1952, Bull. Brooklyn Ent. Soc., **47**, pp. 70 and 78 (adults from trapped *Lophortyx c. californica* in California). Knowlton, 1953, *Op. cit.*, **48**, p. 19 (Nevada: Gord Springs, Lincoln Co., on "quail" [*Lophortyx g. gambelii*]). Furman and Tarshis, 1953, Jl. of Parasitology, **39**, p. 70 (California: on *Lophortyx c. californica;* not found infested with mites). Campbell and Lee, 1953, Studies on Quail Malaria, New Mexico Dept. Fish Game, pp. 4, 17, 20, 21, 49, 50, 51, 52, 68, 69, and 78 (New Mexico: Las Cruces, Dona Ana Co., on *Lophortyx g. gambelii;* near Hot Springs, Sierra Co., on *Lophortyx g. gambelii;* Playas Lake, Hidalgo Co., on *Callipepla squamata pallida;* Isaac Ranch, Dona Ana Co., on quail; near Deming, Luna Co., on quail; Dona Ana, Dona Ana Co.; Anthony, Dona Ana Co. *L. gambelii* and *C. squamata* infected with *Haemoproteus lophortyx*); 1953, Completion Report, New Mexico Project W-41-R, (mimeographed), p. 3. Tarshis, 1953, Science, **118**, pp. 199–202, figs. 1–8 (oöcyst-like bodies on midgut); 1953, Summary of Dissertation, Berkeley, California, p. 1; 1954, Psyche, **61**, p. 58 (technique); 1955, Experimental Parasitology, **4**, No. 5, pp. 464–492, figs. 2 and 9 (digestive and salivary system; transmission of *Haemoproteus lophortyx* to *Lophortyx c. californica*).

Stilbametopa impressa Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 193 (copy of Speiser's redescription).

Stilbometopa expressa Schuurmans Stekhoven, Silva and San Ramon, 1954, Zeitschr. f. Parasitenk., **16**, p. 395 (error for *impressa*).

Distribution and Specimens Examined. UNITED STATES. ARIZONA (recorded by Falcoz, 1930; Ferris, 1930; Gorsuch, 1934): without precise locality from southern Arizona; Flagstaff, Coconino Co.; near Diamond Joe Mine, between Hickenburg and Morristown, Maricopa Co., on *Lophortyx g. gambelii,* Dec. 6 (W.H. Henry); 3 miles S. of Round Valley, Big Sandy Valley, Mohave Co., on *Lophortyx g. gambelii* (A.R. Phillips); Phoenix, Maricopa Co., on *Lophortyx g. gambelii* (A.K. Fisher; C. Stannard); Baboquivari Mts., Pima Co. (W. Benedict); Globe, Gila Co., on *Lophortyx g. gambelii* (D.K. Duncan); Oracle Junction, Pinal Co., on *Lophortyx g. gambelii,* Nov. 5 (H. Keller); Ehrenburg, Yuma Co. (F.H. Parker); Oracle, Pinal Co., on *Lophortyx g. gambelii,* Nov. 15 (G.R. Hungerford); Duncan, Greenlee Co., on domestic chicken (Rowe); Vail, Pima Co., Oct. 28 (C. Beach); Clemenceau, Yavapai Co., on *Lophortyx g. gambelii* (M. Pearce); Rincon Mts., Pima Co., on *Lophortyx g. gambelii* (A.A. Nichols).—CALIFORNIA (recorded by Bigot, 1885; Speiser, 1902; Ferris and Cole, 1922; O'Roke, 1930; Herman, 1944; Herman and Bischoff, 1949; Tarshis, 1952; Furman and Tarshis, 1953): Tehama Co., on *Lophortyx c. californica* (L.V. Compton); Stoneyford, Glenn Co., on *Lophortyx c. californica;* Chiles Ranch, Chiles Valley, Napa Co., on *Lophortyx c. californica,* June 30 to Nov. 16 (I.B. Tarshis); Mt. Hamilton, Sa. Clara Co., on *Lophortyx c. californica;* Watsonville, Sa. Cruz Co., on *Lophortyx californica brunnescens* (I.B. Tarshis); Jolon, Hunter Liggett Military Reservation, Monterey Co., on *Lophortyx c. californica,* Sept. 20 to Jan. 1 (C.V. Duff); Bitterwater, 15 miles S.E. of King City, San Benito Co., on *Lophortyx c. californica* (I. B. Tarshis); Dunes Lakes near Santa Maria, San Luis Obispo Co., on *Lophortyx c. californica* (C. M. Herman); 15 miles S.W. of Sonora, Tuolumne Co., on *Lophortyx c. californica;* Shandon, San Luis Obispo Co., on *Lophortyx c. californica* (I.B. Tarshis and I. McMillan); Cedar Canyon, Cook Spring, Kern Co., on *Lophortyx c. californica* (I.B. Tarshis); Bakersfield, Kern Co., on *Lophortyx c. californica,* Jan. 1 (B.L. Fox); Ventura Co. (D.W. Coquillett); Mohave Desert, San Bernardino Co., on *Accipiter cooperii* (F.W. Hein); Mecca, Riverside Co. (D. Kiler); Upper Palm Canyon, San Jacinto Mts., 3,000 ft., Riverside Co., on *Lophortyx c. californica* (F. Grinnell, Jr.); Hemet, Riverside Co., on *Oreortyx p. picta;* Poway, San Diego Co. (W.W. Baker); other published records also from Orange Co. and Madera Co.—NEVADA (recorded by Knowlton, 1953): Gord Springs, Lincoln Co., on *Lophortyx g. gambelii,* Dec. 12 (W.B. Low).—NEW MEXICO (recorded by Campbell and Lee, 1953, from Sierra Co. on *L. g. gam-*

belii, Luna Co. on quail, and Hidalgo Co. on *Callipepla squamata pallida*) : Las Cruces, Dona Ana Co. on *Lophortyx g. gambelii* (C.D. Lebert).

Mexico: near Granados, State Sonora, 1 ♀ on *Lophortyx douglasii bensoni*, Aug. 10, 1954 (A.R. Phillips).

S. impressa is known at present from the western United States, in California, Nevada, Arizona and New Mexico, and from northwestern Mexico, in Sonora. No doubt its actual range is more extensive and probably covers at least that of the genus *Lophortyx*. The northmost record is from Tehama Co., in about 40° N., and the southmost from Sonora, in 30° N. Although often found with *Lynchia hirsuta*, sometimes on the same individual bird, its distribution is possibly more southern on the whole. It is not known from Idaho, where *L. hirsuta* occurs, but has been taken in Arizona, New Mexico and Sonora, where *L. hirsuta* is unknown.

Known hosts of *S. impressa* (verified individual records in parentheses). Falconiformes (1): *Accipiter cooperii* (1). Galliformes (26): *Callipepla squamata pallida; *Gallus gallus bankiva* (1); *Lophortyx c. californica* (12); *L. californica brunnescens* (1); *L. douglasii bensoni* (1); *L. g. gambelii* (10); *Oreortyx p. picta* (1).

Bionomics. The host relations and population dynamics of *S. impressa*, briefly mentioned in Part I (pp. 318 and 232), will be discussed fully by Dr. I.B. Tarshis in a forthcoming publication. This fly is a very common parasite of California quail, *Lophortyx californica*, the listed records giving only an incomplete idea of its frequency. According to C.R. Hungerford (*in litt.*), it is equally abundant on Gambel's quail, *L. gambelii*, in Arizona, where in November, 1952, at Oracle, he found some 50 per cent of the birds infested, with up to 3 flies per bird. Only *L. californica* and *L. gambelii* are definitely known as breeding hosts. The 2 flies found on *Oreortyx picta* in the same locality, September 27 and October 1, 1948, seem to have been accidental occurrences or were perhaps due to live contamination in traps. Campbell and Lee (1953) mention that *S. impressa* was once taken in Hidalgo Co., New Mexico, on scaly quail, *Callipepla squamata pallida*, possibly as a stray. Dr. Herman obtained some specimens also from introduced chukar partridge, *Alectoris graeca*, kept in captivity in California close to California quail. *S. impressa* has been taken on the host in California from June to the end of December; what happens to it during the remainder of the year is as yet unknown. The infestation reaches its peak in August, September and October.

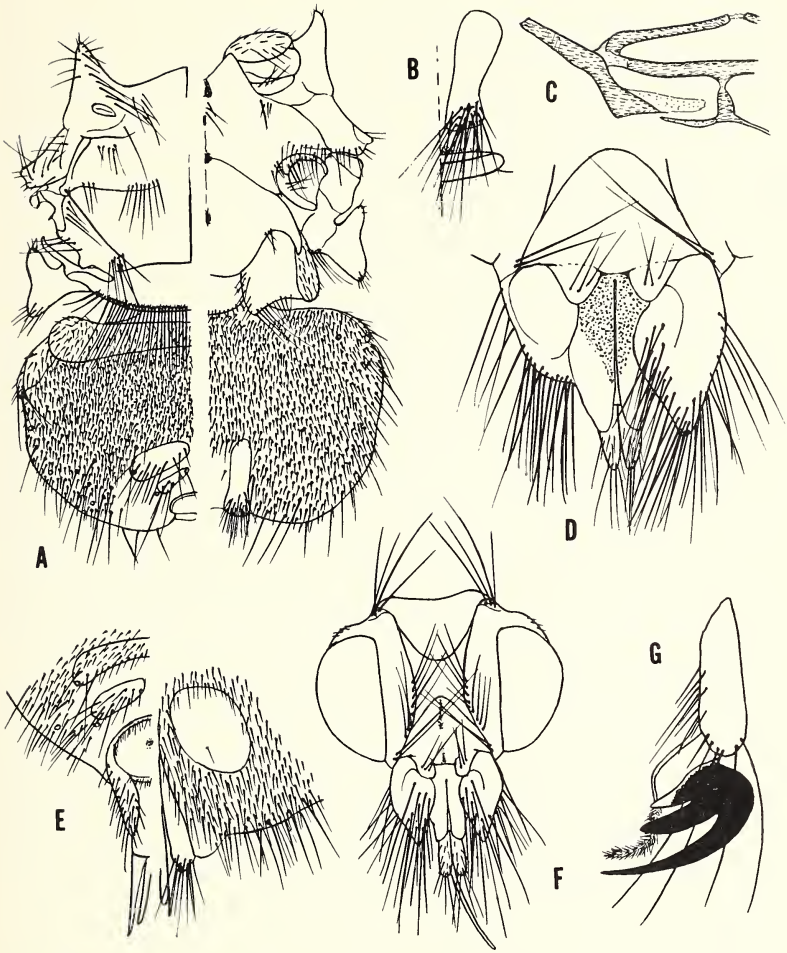

Fig. 47. *Stilbometopa impressa* (Bigot): **A**, thorax and abdomen dorsally and ventrally, ♀, Shandon; **B**, pregenital ventral sclerite, ♀, Shandon; **C**, anal cell, ♂, Bitterwater; **D**, frontal area of head, 2nd segment of one antenna removed, ♀, Bitterwater; **E**, apex of abdomen dorsally and ventrally, ♂, Bitterwater; **F**, head, ♀, Bitterwater; **G**, distitarsus and claw of hind leg, ♀, Bitterwater; all from flies on *Lophortyx c. californica.*

Dr. Tarshis found a puparium of *S. impressa* in the crop of *Lophortyx californica* at Bitterwater, California, on December 16.

Herman (1944, 1945) published a few notes on the larva and puparium and also figured some puparia. The early stages will be described in detail by Dr. I.B. Tarshis. According to specimens received from Dr. Tarshis, the normal, fully-formed puparium (Figs. 50*B–E*) is 5.3 to 5.5 mm. long, 4.9 to 5.1 mm. in greatest width (near mid-length), and about 3.5 mm. thick. It is broadly oval, gradually narrowed to the prominent but small posterior cap bearing the spiracular or polypneustic lobes. In profile, it is decidedly depressed, lenticular, about equally convex dorsally and ventrally, the sides forming well-marked, blunt edges. The surface is bare, moderately shiny, with a rather oily sheen; under a hand-lens it shows only irregularly scattered, shallow, pit-like punctures; but a high magnification discloses in addition a minute network of engraved lines. The broad, semi-elliptical anterior end bears a small, abruptly raised buccal papilla, with a cup-like depression at the tip. The cap at the posterior end is uniformly convex, without the usual apical, median depression or groove, but at the summit with 2 minute pits in a transverse line. The polypneustic lobes form 6 slightly raised broad ridges, 3 on each side, separated by shallow depressions slanting toward the somewhat hexagonal contour of the cap, which itself is elliptical seen from behind; each ridge bears 10 to 12 irregularly scattered respiratory pores each on a small, flattened, circular area.

Part I contains also information, mostly from Dr. I.B. Tarshis' unpublished observations, on the feeding requirements (p. 113), the host as an enemy of the fly (p. 130), the rôle in the transmission of *Haemoproteus lophortyx* (pp. 138 and 358–360), the sex ratio (p. 178), the larviposition (p. 193) and the duration of pupal development (p. 199). Meanwhile, Dr. Tarshis has published two brief summaries of some of his findings (1953*a*, 1953*b*), as well as a detailed account of the experimental transmission of *H. lophortyx* (1955*a*).

According to Furman and Tarshis (1953, p. 70), *S. impressa* was never found infested with mites, although over 1000 flies were carefully examined for such parasites. This is in sharp contrast with *Lynchia hirsuta,* often found with it on the same host, and which shows a high percentage of mite infestation.

Affinities. *S. impressa* is better defined than its congeners, perhaps owing to its geographical isolation and restricted host specificity. Few characters should be added to those of the key. The

slight lateral notch, visible in some specimens between the humeral callosity and the anepisternum, is often not more marked in this species than in others and is not a specific character. The metathoracic pleurotergite is asymmetrical, much as in *S. ramphastonis*, but the relative size of the lobes is too variable to be trusted. There are usually 2 or 3 vertical bristles at each side of the postvertex. The head (Fig. 47*F*) is much the same in both sexes; the interocular face is nearly parallel-sided, about as high as wide and only slightly less than twice the width of an eye. The preäpical dorsal sclerites of the abdomen are larger in the ♂ (Fig. 47*E*) than in the ♀ (Fig. 47*A*), those of the 1st pair often fused medially in the ♂.

Original description of *S. impressa* (French text translated): "Long. 7 mm. Antennis pallide fulvis, nigro villosis; haustello superne ejusdem coloris; fronte castanea; epistomate, lateribus et macula trigona verticis nitidis; oculis rufis; thorace nitido, fusco nigro, linea mediana, sutura profunde impressa, scapulisque flavidis, utrinque puncto prope radicem alarum flavido; scutello, apice, dense nigro villoso; abdomine nigro, nigro villosulo; pedibus sordide testaceis, femoribus, superne, tibiis, intus et externe sed anguste, fuscis; alis fere hyalinis, venis, costali, longitudinalibus 1–4is omnino, 5a, parum ultra transversam 1am nigram, nigro pictis, transversa 2a pallidissima. Brownish-black. Antennae, upper side of proboscis, fulvous-yellow; long, black setae on antennae; frons [interocular face] brown, triangle on vertex [postvertex], inner margin of orbits, epistome [frons], shiny; eyes reddish; thorax blackish-brown, shiny, with the longitudinal furrow and suture deeply marked; scutellum with a strong longitudinal furrow; humeral protuberance yellowish, with a basal blackish spot and a yellowish dot near base of wing; scutellum with a long fringe of stiff, black setae; abdomen dull black, with small black setae; legs pale fulvous; a few black setae on femora, above; inner and outer edges of tibiae brownish; hind tarsi black; wings nearly hyaline; entire costa and 1st to 4th longitudinal veins, the 5th longitudinal to a little beyond 1st cross-vein, the 6th longitudinal to 2nd (inner) cross-vein, and the 1st (outer) cross-vein, black; 2nd cross-vein and remainder of veins pale. The two basal cells very unequal; 2nd longitudinal vein meeting 1st and the two meeting costa opposite 1st cross-vein." The specimen which I saw in 1951 labelled as type in the old Bigot Collection, now part of the J.E. Collin Collection at Newmarket, is a male taken in California by Lord Elsingham in 1873. Its wing is 8 mm. long. The Bigot Collection contains also a female of the species, from the same source, so that the original description was presumably based on both sexes. The specimens agree with the customary interpretation of the *Stilbometopa* of California quail.

Both specimens were studied by Speiser (1902), who described them in detail as follows (translated from the German): "Length, 7 mm.; from oral margin to hind margin of scutellum, 4.5 mm.; of wing 8 mm. Very dark olivaceous-brown with paler legs, mouth-parts and areas on thorax. Of very robust build; femora not as narrow as usual in Hippoboscidae. Head broader than long, with wide antennal appendages as in *Ornithoctona;* but between them the 'clypeus oris' [frons] extends forward in the shape of a narrow peg composed of two halves separated by a deep slit. The 'clypeus oris' [frons] is entirely horn-yellow (as are also the antennal appendages bearing black bristles), about $\frac{2}{3}$ of the length of remainder of "Stirn' [mediovertex + postvertex] and with a round, small pit near upper margin. Postvertex about the shape of an equilateral triangle bluntly rounded off anteriorly, with anterior margin about as far from frontal suture [ptilinal suture] as the length of postvertex. Face equally wide throughout. The maxillary palps (sheath of the proboscis) extend only very

slightly beyond the 'clypeus' [frons]. The thorax is not only provided anteriorly, on either side of head, with a pair of spiniform protuberances [humeral callosities], but the pleuron is also extended on each side, before hinge of wing, as a strong spine, yellow at tip. The scutellum is actually long, as it were pillow-shaped and continues laterally in a pair of short ledges which are separated by furrows from the hind margin of the 'scutum mesonoti' [mesoscutum]. However, a very conspicuous structure stands out ventrally from these ledges; from the cavity bearing the halteres, between wings and scutellum, two large hammer-shaped (or better, halter-shaped), solid structures [modified metathoracic pleurotergites] project, whitish-yellow with several black bristles; they recall in shape somewhat the appendages on the prothorax of *Podops inunctus* Fabr., one of the Hemiptera. These structures must be referred to the metathorax from their position, which makes them particularly remarkable. I was unable to determine their relation to the second pair of spiracles; but in any case the halteres are placed below and behind them. This structure is very striking, more so than the scutellum; we find on the latter a row of notches, as mentioned by Coquillett, and a strong festoon of very heavy, black bristles, concavely curved downward, which continue laterally on the ledges mentioned above, becoming of course gradually smaller.''

Stilbometopa podopostyla Speiser

Figs. 46*B*, 48*A*, 49*A*, and 50*G* and *K*

Stilbometopa podopostyla Speiser, 1904, Ann. Mus. Nat. Hungarici, **2**, p. 394 (no sex; no host. Brazil: States of Matto Grosso and Rio Grande do Sul, without precise locality. Five cotypes, 1 in Budapest Mus., 1 in Berlin Mus., 3 in Vienna Mus.); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 178 and 196; Pl. 27, fig. 1; Pl. 28, fig. 1 (no sex. Brazil: on *Scardafella ''squamosa''* [*S. s. squammata*] and *Columba rufina sylvestris*, in the States of Minas Gerais, Espirito Santo and Piauhy). Bau, 1930, Konowia, **9**, pt. 3, p. 210 (Bolivia: N. Chiquitos). J. Bequaert, 1935, Revista de Entomologia, Rio de Janeiro, **5**, pp. 324 and 325, fig. 1*C*. Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 893. Brennan, 1938, Science, **88**, p. 571 (Texas: San Antonio, on *Zenaidura macroura carolinensis*). J. Bequaert, 1939, *Op. cit.*, **89**, p. 268. Huff, 1939, Jl. Amer. Vet. Med. Assoc., **94**, p. 619. Howell and Stiles, 1941, Jl. Amer. Med. Assoc., **116**, p. 1517 (Oklahoma: biting Man). McClure, 1943, Iowa Agric. Expt. Sta., Research Bull., **310**, p. 406. J. Bequaert, 1943, Bol. Entom. Venezolana, **1**, (for 1942), No. 4, p. 81; 1943, Jl. of Parasitology, **29**, p. 132. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Herms, 1950, Medical Entomology, 4th Ed., p. 414. Schuurmans Stekhoven, 1952, Beiträge zur Fauna Perus, **3**, Wissensch. Bearbeit., pp. 91 and 101 (Peru: Huayuri, in pigeon nests). Figueroa, 1952, Acta Agron., Palmira, **3**, pt. 1, p. 5 (Colombia: Palmira, on domestic pigeon).

Stribbometopa podopostyla Lizerand, 1953, Maladies du Gibier à Plumes, (Paris), p. 94.

Stilbometopa podostyla Bodkin, 1919, Brit. Guiana Dept. Sci. Agric., Rept. for 1917, p. 62 (British Guiana: N.W. District, on *Leptotila verreauxi*). Error for *podopostyla*.

Stilbometopa nepodostyla Cleare, 1919, Brit. Guiana Med. Annual for 1919, 22nd Year, Demerara, p. 70 (same record as Bodkin, 1919). Error for *podopostyla*.

Stilbometopa podopystyla Coatney, 1938, Science, **88**, p. 258 (Nebraska: Peru, on *Zenaidura macroura carolinensis*). Coatney and West, 1940, Amer. Jl. Hyg., **31**, Sect. C, p. 12. Error for *podopostyla*.

Stilbometopa columbarum Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, 7, p. 178 (no sex; name proposed tentatively for specimens from Brazil referred to *podopostyla,* as listed above, and regarded as cotypes of *columbarum*).

Distribution and Specimens Examined. UNITED STATES. ARIZONA: Arlington, Maricopa Co., on *Zenaida a. asiatica,* June 7 (A. Wetmore). — KANSAS: Salina, Salina Co., on wild pigeon (E. Moore). — NEBRASKA (recorded by Coatney, 1938; Coatney and West, 1940): Peru, Nemaha Co., on *Zenaidura macroura carolinensis,* Sept. (G.R. Coatney). — OKLAHOMA (recorded by Howell and Stiles, 1941): Ponca City, Kay Co., biting Man, June 8 (Arfte; D.E. Howell and G.W. Stiles). — TEXAS (recorded by Brennan, 1938): near San Antonio, Bexar Co., on *Zenaidura macroura carolinensis,* Sept. 24 (J.M. Brennan).

MEXICO: San José del Cabo, Baja California, on *Zenaidura macroura marginella* (G. Augustson); La Majada, Munic. Apatzingan, 1200 m., State of Michoacan, ♀ ♂ on dove (H. Hoogstraal and R. Traub); Champotón, State of Campeche, on *Leptotila verreauxi fulviventris* (R.A. Paynter, Jr.).

GUATEMALA: Uaxactun, Petén, on *Crypturellus b. boucardi* (J. Van Tyne).

REPUBLIC OF HONDURAS: Lancetilla near Tela.

COLOMBIA (recorded by Figueroa, 1953): Buga, Dept. Valle del Cauca, on domestic pigeon (S. Renjifo-Salcedo); Cali, Dept. Valle del Cauca, on domestic pigeon (S. Renjifo-Salcedo); Palmira, Dept. Valle del Cauca, on domestic pigeon (P. Losada S.).

VENEZUELA: Los Robles, Guaira, on *Leptotila v. verreauxi* (P. Anduze).

BRITISH GUIANA (recorded by Bodkin, 1919, as *S. podostyla:* Cleare, 1919).

BRAZIL (recorded by Speiser, 1904; Lutz, Neiva and da Costa Lima, 1915, as *S. podopostyla* or *S. columbarum*): Nova Teutonia near Itá, State of Santa Catharina, on *Columba rufina sylvestris, Tinamus solitarius, Crypturellus o. obsoletus,* and *Chamaeza c. campanisona* (F. Plaumann); Ipamiry, State of Goyaz, ♂ on domestic turkey (J. Lane); State of Goyaz, on dove (J. Lane); Japuhyba near Angra dos Reis, State of Rio de Janeiro (L. Travassos); Hyutanaban, Rio Purús, State of Amazonas, on *Tinamus* sp. (S.M. Klages); near Cachoeira, State of Rio Grande do Sul, on "caracua" (Henninger); Lassance, State of Minas Gerais, on *Scardafella s. squammata* (Ad. Lutz. — Cotype ♀ of *S. columbarum*); Ilha Seca, State São Paulo (Inst.Osw.Cruz); Paranagua, State of Piauhy, on *Columba rufina sylvestris* (A. Neiva. — Cotype ♀ of *S. colum-*

barum) ; Barra do Tibagí, Rio Paranapanema, State of São Paulo, on *Leptotila verreauxi decipiens.*

Paraguay: San Bernardino (K. Fiebrig) ; Villarrica, ♂ on domestic chicken (F. Schade).

Ecuador: Guayaquil, on domestic pigeon (F. Campos R.).

Peru (recorded by Schuurmans Stekhoven, 1952) : Valle Chanchamayo (W. Weyrauch).

Bolivia (recorded by Bau, 1930).

Argentina: Las Palmas, Chaco, on *Leptotila verreauxi chalcauchenia* (A. Wetmore) ; Cerro de San Javier, Prov. Tucumán, on *Leptotila verreauxi chalcochenia* (O. Budin and Gomez).

S. podopostyla is essentially a Neotropical insect, common and widespread throughout continental Central and South America. In the Antilles it appears to be replaced by *S. fulvifrons.* The few Nearctic records seem to be based on stray flies arriving in the spring from farther south on migratory hosts or acquired from such during the summer by other birds. It is doubtful that the species can maintain itself permanently through the winter north of the Tropic of Cancer. The northmost capture is from Nebraska in about 40° 30′ N. and the southmost from northern Argentina in about 27° S.

Known Hosts of *S. podopostyla* (verified individual records in parentheses). Tinamiformes (4) : *Crypturellus b. boucardi* (1) ; *C. o. obsoletus* (1) ; *Tinamus* sp. (1) ; *T. solitarius* (1). Galliformes (2) : **Gallus gallus bankiva* (1) ; *Meleagris g. gallopavo* (1; on domesticated birds). Columbiformes (17 and 2 unidentified doves) : **Columba l. livia* (5) ; *C. rufina sylvestris* (2) ; *Leptotila v. verreauxi* (1) ; *L. verreauxi chalcauchenia* (2) ; *L. verreauxi decipiens* (1) ; *L. verreauxi fulviventris* (1) ; *Scardafella s. squammata* (1) ; *Zenaida a. asiatica* (1) ; *Zenaidura macroura carolinensis* (2) ; *Z. macroura marginella* (1). Passeriformes (1) : *Chamaeza c. campanisona* (1).

Bionomics. What little is known of these for *S. podopostyla* was mentioned in Part I in discussing infestation with mites (p. 155), host relations (p. 329) and effect of the bite on Man (p. 344).

The host records, though few, show conclusively that wild Columbidae are the main breeding hosts, from which the fly passes sometimes to domestic pigeons. Tinamous also are possibly effective breeding hosts. The very few occurrences on other types of birds (2 on domesticated Galliformes and 1 on a Passeriformis) may be dismissed as accidental.

In the Nearctic Region, 4 of the 5 records are from wild doves and the fifth is based on an attack on Man; all are, moreover, from

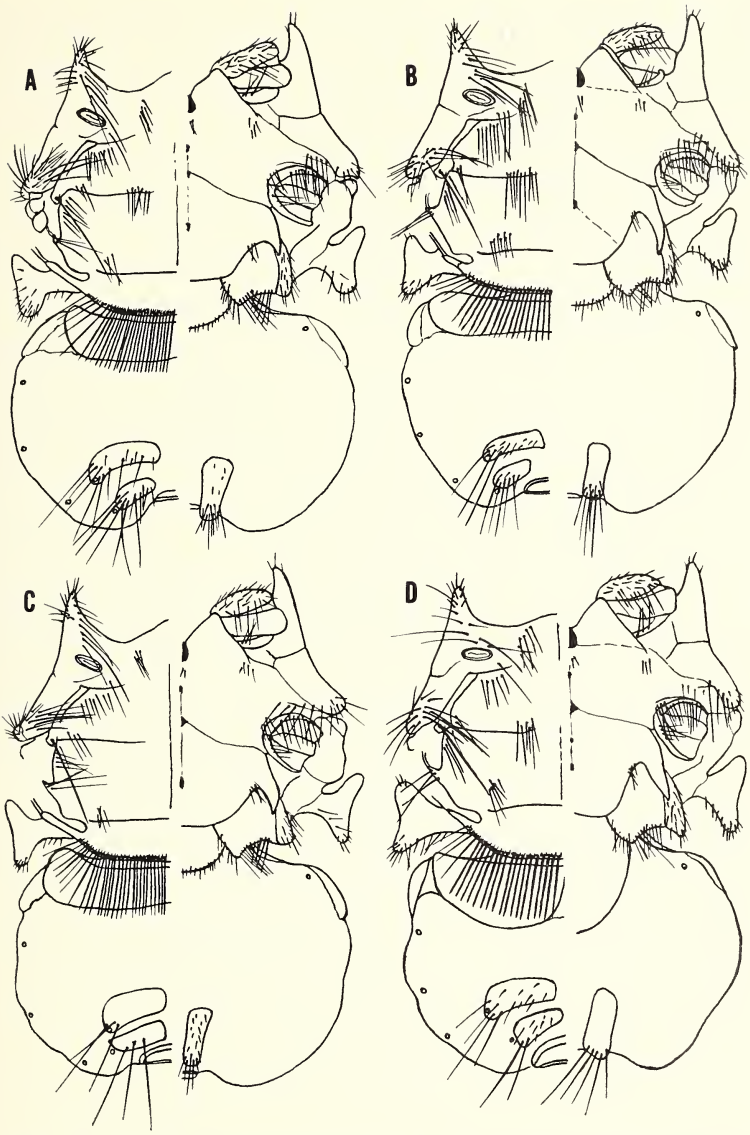

Fig. 48. Thorax and abdomen dorsally and ventrally of *Stilbometopa:* **A**, *S. podopostyla* Speiser, ♀, Champotón, on *Leptotila verreauxi fulviventris;* **B**, *S. ramphastonis* Ferris, ♀, Joinville, on *Pipile jacutinga;* **C**, *S. fulvifrons* (Walker), ♀, Baraguá; **D**, *S. legtersi* J. Bequaert, ♀ holotype, Xocempich. Setae of abdomen shown on basal and preäpical sclerites only.

the summer months (June to September). These seasonal and sporadic captures, in spite of the large size, suggest that *S. podopostyla* is not a permanent member of the Nearctic fauna, but is unable to survive the winter there either as adult or as puparium.

Affinities. *S. podopostyla, S. fulvifrons,* and *S. ramphastonis* are very closely related and Ferris (1930*c*, p. 64) suggested the possibility that they might be "the same thing." The material available of *S. fulvifrons* and *S. ramphastonis* is too scant to settle their status conclusively; in particular, more information is needed on the true breeding hosts. *S. podopostyla* and *fulvifrons,* however, differ markedly in the size of the metasternal spurs. Other minor differences are more difficult to appreciate except by direct comparison, and this is particularly true for the shape of the outer hind edge of the anepisternum. In both species the median occipital inward curve is similar, but somewhat deeper and narrower in *podopostyla.* It is wider and shallower in *S. ramphastonis,* which, moreover, shows other, presumably more reliable differences given in the key. The presence or absence of a pit on the postvertex and the length of the tips of the antennal processes, used in an earlier key (1935*b*, p. 324), appear unreliable when the specimens are sorted by the length of the metasternal spur. In the ♀ the two pairs of preänal dorsal sclerites are much less setose in *S. fulvifrons* than in *S. podopostyla.*

The sexes differ little; but the four posterior tergal and the two ventral preäpical sclerites of the abdomen are much larger in the ♂. The interocular face is about the same width in both sexes (Fig. 49*A*); it is about as wide at the upper eye margins as high and often more narrowed toward the lunula than in *S. fulvifrons.*

Original description of *S. podopostyla* (translated from the German): "Length, 6.5 mm.; from margin of mouth to scutellum, 4.5 mm. Umber-brown, with leather-brown markings. Head yellowish-brown. Clypeus [frons], margins of eyes [inner orbits] and triangle of vertex [postvertex] somewhat darker. Occiput produced posteriorly for some distance above hind margin of eye, and this area emarginate behind. Triangle of vertex [postvertex] with a very fine median excision anteriorly. Inner sides of broad, shiny margins of eyes [inner orbits] convergent forward. Clypeus [frons] of the usual, sharp bow-shape, with rather deep pit. Antennal appendages broad and flat, rather long, longer than maxillary palpi, which are straight and narrow. Under side of head uniformly leather-yellow. Structure of thorax exactly as I described in detail for *S. impressa,* except that in my new species the spines before the wing articulation are not as strong and long, and should be called knobs rather than spines. I have named the species for the characteristic hammer-shaped appendages of the metathorax, which recall those on the pronotum of the bug *Podops inuncta* Fabr. The ground color of the thorax is dark brown with a bronze-green gloss. Middle of anterior margin with a pair of narrow yellowish-brown streaks, which barely reach the transverse suture. The humeri also are yellowish-brown, pale particularly on the edge, and with an almost bone-white stripe from outer edge to base of wing. On either side of scutellum two paler brown spots, difficult to see; middle line of scutellum distinctly paler brownish and its hind and side

margins less distinctly so; the processes mentioned before are whitish-yellow; under side of thorax uniformly bronze-brown. Fore legs leather-yellow, with only tarsi somewhat darker; mid and hind legs brownish-yellow, with tarsi and inner and outer edges of tibiae dark-brown. Wings brownish, transparent. Subcostalis [1st longitudinal] ending in costa opposite or slightly beyond small [anterior] cross-vein; radialis [2nd longitudinal] nearer cubitalis [3rd longitudinal], so that the terminal sector of costa is to the penultimate sector as 2 : 3. The small [anterior] cross-vein is very slightly oblique, slanting from basad above to apicad below; posterior [2nd] basal cell more than half the length of anterior [1st]; anal cell less than half the length of posterior [2nd] basal. Abdomen without peculiarities, black, covered with rather long black setae; a broad basal segment, and before anal opening on each side a wart-shaped knob bearing long black setae.'' I have not seen any of the cotypes; but the description suffices to recognize the species.

S. columbarum. Lutz, Neiva and da Costa Lima (1915) referred doubtfully to *S. podopostyla* specimens from Brazil, taken on two wild species of Columbidae. They figured the scutellum and wing and added the following notes (translated from the Portuguese): ''Comparing this species [*podopostyla*] with ours we conclude that the slight differences noted do not allow us to exclude that they are identical. The main difference is in the absence of submedian and longitudinal grayish-yellow streaks over the middle of the scutum anteriorly. There are other color differences, but of minor importance, as they vary in our specimens. In addition, the venation of the wings shows small differences, the sternum in some specimens is tortoise color, the anterior margin of the scutum may be pale yellow, and finally the wings are a diluted honey-yellow, slightly infuscated, being in one specimen scarcely yellow.'' The trivial name *columbarum* was tentatively proposed for these specimens, in case they were later recognized as specifically distinct from *S. podopostyla.* Some of them, now at the Instituto Oswaldo Cruz, were examined through the kindness of Dr. H. de Souza Lopes. I could find no reliable character separating them from *S. podopostyla.*

Stilbometopa fulvifrons (Walker)

Figs. 46*C*, 48*C*, 49*B*, and 50*H* and *L*

Ornithomyia fulvifrons Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1145 (no sex. Jamaica, on ''*Ortyx virginianus*'' [*Colinus virginianus*]. Type ♂ at Brit.Mus.). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Johnson, 1894, Proc. Ac. Nat. Sci. Philadelphia, p. 281. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 190 (copy of description).

Stilbometopa fulvifrons Coquillett, 1899, Canad. Entom., **31**, p. 336. Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 263 (type. Also from Jamaica: on *Saurothera vetula, Geotrygon ''sylvatica''* [*G. versicolor*], *''Geotrygon''* [*Oreopeleia*] *montana*, and *''Tityra leuconotus''* [*Platypsaris niger*]). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 654 (also listed here as *Ornithomyia fulvifrons*). Speiser, 1907, Ent. News, **18**, p. 103; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 364. Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull., **4**, pts. 1–2, p. 89 (misspelled *''fulviforns''*). J. Bequaert, 1935, Revista de Entomologia, Rio de Janeiro, **5**, p. 324, fig. 1*D*; 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, p. 318. Thompson, 1949, Ent. Mo. Mag., **85**, p. 248 (Jamaica: 14½ miles E. of Kingston, St. Thomas).

Distribution and Specimens Examined. United States. New Jersey: Demarest, Bergen Co., on *Hylocichla mustelina*, May 4 (B.S. Bowdish).

Antilles. Bahamas: Great Salt Cay. — Cuba: without precise locality (P. Poey and J. Gundlach); Holguin, Prov. Oriente, on pigeon; mouth of Río Ojo del Toro, Prov. Oriente, Aug. 30, on *Holoquisqualis jamaicensis gundlachii* (H.S. Peters); Baraguá, Prov. Oriente (L.C. Scaramuzza). — Isle of Pines: Los Indios, on *Columba leucocephala* (G. Link). — Jamaica (recorded by Walker, 1849; Austen, 1903; Thompson, 1949): without precise locality, on *Colinus virginianus* (♂ type of *fulvifrons*), *Saurothera v. vetula, Geotrygon versicolor,* and *Oreopeleia m. montana* (P.H. Gosse. — Brit.Mus.); 14½ miles E. of Kingston on Morant Bay Road, St. Thomas (G.B. Thompson).

Costa Rica: La Fuente, ♀ (A. Alfaro).

S. fulvifrons is known thus far mainly from the Greater Antilles and the Bahamas, which may be its normal habitat. The only record from Central America could be accidental. The one capture in New Jersey was on a woodthrush, a bird known to migrate occasionally to the Bahamas, Cuba and Jamaica, though it winters more often in Central America. This seems to be a case of straggling and hardly makes *S. fulvifrons* a regular member of the Nearctic fauna (see Part I, p. 234).

Known Hosts of *S. fulvifrons* (verified individual records in parentheses). [Galliformes (1): *Colinus virginianus* (1; on introduced bird in Jamaica)]. Columbiformes (3 and 1 unidentified pigeon): *Columba leucocephala* (1); *Geotrygon versicolor* (1); *Oreopeleia m. montana* (1). Cuculiformes (1): *Saurothera v. vetula* (1). Passeriformes (2): *Holoquiscalis jamaicensis gundlachii* (1); *Hylocichla mustelina* (1); *Platypsaris niger.*

Bionomics. Of the 8 verified records, 4 are from Columbidae, which I regard as the true breeding hosts, mainly because *S. fulvifrons* seems to replace *S. podopostyla* in the Antilles. The remaining records from wild birds are scattered among the Cuculidae, Muscicapidae and Icteridae, and the species has also been reported from one of the Cotingidae (*Platypsaris*); all these are probably accidental occurrences. Walker's so-called "type-host," the North American bob-white quail, *Colinus virginianus,* is not native in Jamaica, where it was introduced by Man. No species of *Stilbometopa* was ever taken on *Colinus* in North America.

Affinities. These have been discussed under *S. podopostyla,* with which *S. fulvifrons* is closely related in spite of the long metasternal spurs. Whether the slight differences in the shape of the occipital margin and the interocular face are fully reliable remains open to question. It should be noted that the metasternal spurs of *S. fulvi-*

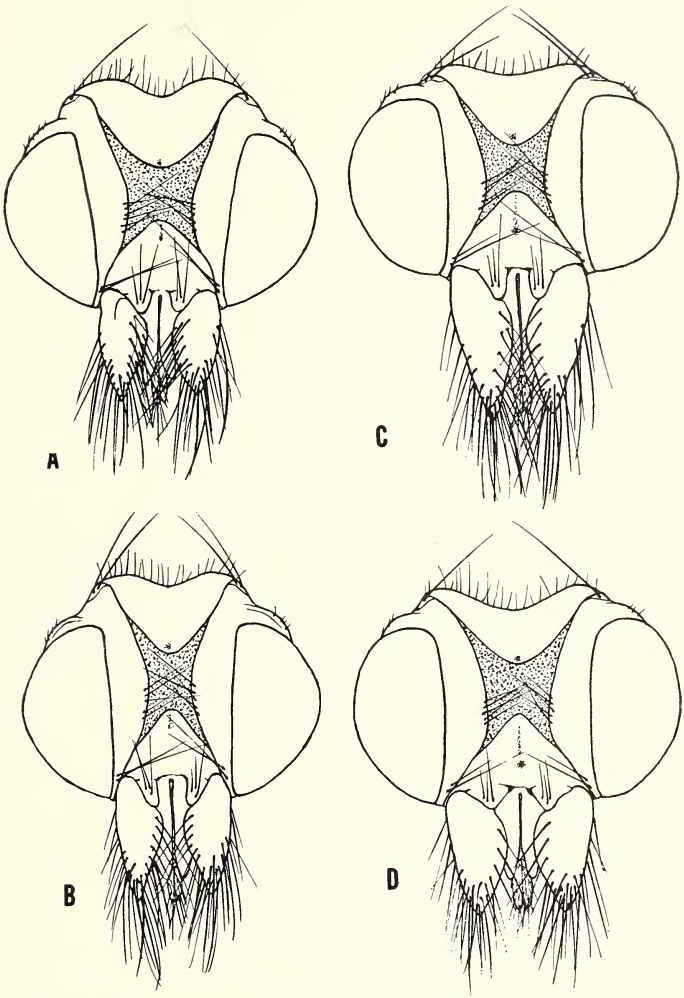

Fig. 49. Heads of *Stilbometopa:* **A**, *S. podopostyla* Speiser, ♀, Las Palmas, on *Leptotila verreauxi chalcauchenia;* **B**, *S. fulvifrons* (Walker), ♀, Los Indios, on *Columba leucocephala;* **C**, *S. ramphastonis* Ferris, ♀, Sto Thomas, Izabal, on *Ramphastos* sp.; **D**, *S. legtersi* J. Bequaert, ♀ holotype, Xocempich.

frons are always shorter than those of *S. ramphastonis*, not reaching beyond mid-length of the hind coxa.

Original description of *O. fulvifrons:* "Picea, capite antico fulvo, thoracis spinis apice flavis, pedibus fusco-fulvis, tarsis piceis, alis limpidis. Body pitchy, smooth, shining: fore part of head, mouth and all the appendages bright tawny, beset with tawny bristles; crown dull in the middle, where one longitudinal and two diagonal furrows meet: a large spine, pale yellow toward the tip, projecting on each side of the fore border of the chest, whose two furrows are obsolete at their point of intersection: hind border of the scutcheon armed with a row of short black bristles: abdomen dull, clothed with short black hairs: legs brownish tawny, beset with black bristles; feet pitchy; knees and claws black; foot-cushions yellow: wings colourless; wing-ribs and veins pitchy; fore border veins black. Length of the body 2 lines [2.3 mm.]; of the wings [span of wings] 6 lines [12.7 mm.]." I have seen the type, a male labelled "Jamaica, *Ortyx virginianus,*" at the British Museum in 1951. According to Dr. G.B. Fairchild (*in litt.*, 1953), the wing has lost the tip, what remains being 6.8 mm. long; originally it may have been 1 to 2 mm. longer. A sketch kindly made by Dr. H. Oldroyd, shows that the metasternal spurs of Walker's type are almost exactly as in my Fig. 48*C*; they would reach to mid-length of the hind coxae if the latter were pushed back in the articulations with the sternum.

Stilbometopa ramphastonis Ferris

Figs. 46*D*, 48*B*, 49*C*, and 50*I* and *M*

Stilbometopa ramphastonis Ferris, 1930, Canad. Entom., **62**, p. 63, figs. 1 and 2*A-D* and *F* (♀. Panama: Camp Pital, Chiriqui Prov., on *Ramphastos swainsonii.* Type at Stanford Univ., Palo Alto, California). Dunn, 1934, Psyche, **41**, p. 175. J. Bequaert, 1935, Revista de Entomologia, Rio de Janeiro, **5**, pp. 323 and 325, fig. B; 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 318 and 319; Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416. Guimarães, 1944, Papéis Avulsos Depto. Zool., São Paulo, **4**, No. 5, p. 79; Pl., figs. 1–2 (Brazil: Rio S. José, State of Espirito Santo, on "*Trogonurus*" [*Trogon*] *surrucura aurantius,* with 3 Mallophaga, *Degeeriella odontopleuron* Guimarães, attached).

Stilpometopa ramphastonis Guimarães, 1944, Papéis Avulsos Depto. Zool., São Paulo, **4**, No. 5, p. 82.

Distribution and Specimens Examined. Guatemala: Sto Thomás, Izabal, on *Ramphastos* sp., ♀ with Mallophagan attached at about mid-length to the edge of the right side of the abdomen.

Costa Rica: Turrialba, on wild pigeon [? *Columba rufina pallidicrissa*] (K.C. Cooper).

Panama (recorded by Ferris, 1930; Dunn, 1934): Gamboa (J.G. Sanders); Camp Pital, Chiriqui Prov., on *Ramphastos swainsonii* (L.H. Dunn. — Holotype of *ramphastonis*); Tapia, C.Z., ♂ on *Columba speciosa* (J.P. Chapin).

Antilles. [? Cuba: Rangel, Prov. Pinar del Río, ♂ (Hno. Chrysozone. — Received from C.P. Alexander)]. — Hispaniola: Santo Domingo, without precise locality (Tweedie. — Brit.Mus.).

Brazil (recorded by Guimarães, 1944): Humboldt, State of Sa. Catharina, on *Muscivora tyrannus* (W. Ehrhardt); Joinville, near

Humboldt, State of Sa. Catharina, ♀ on *Pipile jacutinga* (W. Ehrhardt).

Ecuador: Hacienda Guillermina, Abitagua, 1100 m., Prov. Oriente, on small green toucan (W. Clarke-McIntyre).

S. ramphastonis is strictly Neotropical, both on the Continent and in the Antilles. No doubt it is more widely distributed than the few known captures indicate.

Known hosts of *S. ramphastonis* (verified individual records in parentheses). Columbiformes (1): *Columba* sp. (1). Galliformes (1): *Pipile jacutinga* (1). Trogoniformes: *Trogon surrucura aurantius.* Piciformes (1 and 2 unidentified toucans): *Ramphastos swainsonii* (1). Passeriformes (1): *Muscivora tyrannus* (1).

Bionomics. Practically nothing is known of the life history of *S. ramphastonis.* It is not yet possible to surmise what the true or preferred breeding hosts might be, the records being far too few and too sporadic. A nearly full-grown larva partly protruding from a fly from Izabal, Guatemala, shows a polypneustic cap like that of *S. impressa,* but relatively larger, with the six radiating, broad, convex ridges more pronounced, separated by very deep grooves; respiratory pores irregularly distributed, 12 to 16 on each ridge. Part of the body visible near the cap bears the same scattered, pit-like punctures on the integument as in *S. impressa.*

Two cases of phoresy of Mallophaga, one of them also mentioned above, were recorded in Part I (p. 172).

Affinities. The following characters supplement those of the key. Process of metathoracic pleurotergite asymmetrical, the forward lobe decidedly narrower than the hind lobe, which is more broadly triangular; but the shape of the lobes varies somewhat. The shape of the antennal process also varies intraspecifically and is not to be trusted. Vertical bristles from 1 to 3 on each side. Notopleuron completely separated from prescutum by a suture, which sometimes is less conspicuous behind than in front. Metasternal spurs usually longer than in *S. fulvifrons,* often extending beyond mid-length of hind coxa.

The *male* (allotype) of *S. ramphastonis,* from Tapia, agrees with the ♀ except in the terminalia and the usual sexual differences in the preäpical sternites and tergites of the abdomen. Wing 8 mm. long. As compared with *S. legtersi* (Fig. 50*A*), basal sternite (as in ♀) short and regularly transverse, without deep, median notch; 1st pair of preäpical tergites completely fused into a transverse, ribbon-shaped sclerite not contracted medially; 2nd pair touching or perhaps partially fused medially; all preäpical tergites at the sides with

more long, stiff bristles than in *legtersi;* preäpical sternites as large as in *legtersi*, being in that species and in *ramphastonis* much larger than in *S. impressa* (Fig. 47*E*).

The male from Rangel, listed above, is referred only tentatively to *S. ramphastonis,* with which it agrees in most characters, notably in the shape of the anepisternum, the very long metasternal spurs, and the broad, shallow inward curve of the occipital margin. It differs, however, in that the notopleuron is only incompletely divided from the prescutum, the two being fused over nearly the posterior half (as in *S. fulvifrons*). The wing is 8 mm. long. Future collecting in Cuba will have to decide whether or not this male belongs to another species, possibly undescribed.

Original description of *S. ramphastonis:* "Female. Length on slide, 9 mm.; length of wing, 9 mm. Head, with the antennae and their hairs, of a light red color both dorsally and ventrally, the eyes dark; thorax above glistening black, venter of thorax black; front legs reddish, others black; wings brownish. As compared with *S. impressa* this species is distinguished structurally chiefly by the form of the anepisternum of the mesothorax. In *S. impressa* this sclerite forms a short angular truncate process, while in *S. ramphastonis* it is smoothly rounded and not at all prominent. The pleurotergal process has the posterior angle obtuse, while in *S. impressa* it is quite strongly produced. The head in *S. impressa* is noticeably shorter and relatively broader, with antennae apparently smaller and shorter. Otherwise there seems to be but little difference between the two species except in color, *S. impressa* having the head black. Also in *S. impressa* the wings are distinctly paler, being quite hyaline and the anal vein is very indistinct." I was able to study the holotype at the Museum of Stanford University in 1953. The species is easily recognized from the original description and figures. It should be noted, however, that the shape of the metathoracic pleurotergal process varies and is not always as figured by Ferris.

Stilbometopa legtersi, new species

Figs. 46*E*, 48*D*, 49*D*, and 50*J* and *N*

? *Stilbometopa* sp. Travassos and Teixeira de Freitas, 1941, Mem. Inst. Osw. Cruz, 35, (for 1940), pt. 3, p. 538 (Brazil: Salobra, State of Matto Grosso, on *Ortalis canicollis pantanalensis*).

Female. Head (Fig. 49*D*) seen in front about $1\frac{1}{3}$ times as wide across eyes as high from occipital margin to tip of interantennal area of frons. Interocular face almost parallel-sided, at its narrowest nearly $1\frac{2}{3}$ times the width of an eye, scarcely higher than wide. Inner orbit smooth, at its widest slightly over half the width of mediovertex; orbital bristles very few and weak, 3 or 4 in a short, irregular row at about mid-height of face and 1 or 2 short ones near lower corner of lunula. One moderately long vertical bristle (also in ♀ paratypes). Occipital margin with a deep, broad, very even, median inward curve and distinct lateral sinuosities between postvertex and hind margin of upper orbits. Postvertex crescent-

shaped, slightly shorter than mediovertex, smooth, evenly curved and entire anteriorly, without pit or depression. Frons: lunula about as long as mediovertex, triangular with broadly rounded upper angle, smooth, the upper half with a shallow longitudinal depression ending in a slight median pit; lower portion of frons only superficially divided from lunula at extreme sides (close to antennae), forming a broad interantennal area, about as long as lunula, slanting roof-like under antennal appendages, divided over most of its length by a linear slit whose margins diverge slightly apicad at the palpi. Antenna (Fig. 50*N*) : 1st segment only partly divided from the lunula by short depressions at the inner and outer corners, smooth and bare; leaf-shaped appendage of 2nd segment broader than usual in the genus, nearly twice as long as wide, elongate oval, the apical third broadly triangular with bluntly rounded apex, the inner and outer margins about equally convex; surface of appendage with only a short inner basal, elongate depression, moderately setose, longer bristles restricted to outer apical area. Palpi short, moderately thick, extending little beyond tips of antennal appendages, with a few scattered short setae and longer bristles apically. Head beneath with many long bristles (vibrissae) irregularly bunched on upper side ridges of buccal cavity. Thorax (Fig. 48*D*) about $1\frac{1}{4}$ times as wide as long seen from above, shaped as usual in the genus, except as follows: anterior margin of prescutum deeply bisinuate, broadly and evenly convex in the middle, the corresponding swollen antero-median third of prescutum forming an elongate, triangular welt with the long, narrow apex directed backward; suture between humeral callosity and anepisternum obsolete, replaced by the raised hind margin of the callosity; notopleuron completely divided from prescutum by a suture which is only somewhat weaker behind; outer hind edge of dorsal anepisternum forming a simple, narrow, bluntly pointed, low lobe, directed backward, without lateral projecting angle; metathoracic pleurotergite with a nearly symmetrical anvil-shaped process, the posterior lobe being somewhat more conical than the anterior lobe but about the same length; humeral callosity with a row of 3 or 4 long bristles in front, 1 bristle at inner side of spiracle, and a few erect, short setae on the projecting point; a few setae, 2 very long, on posterior third of anepisternum; one long notopleural bristle; 2 long postalar bristles; in addition, scutum with small patches of short, irregular rows of appressed setae at inner border of humeral callosity, immediately behind posthumeral suture, in outer hind corner of prescutum, in the depression at inner end of transverse mesonotal suture, and in

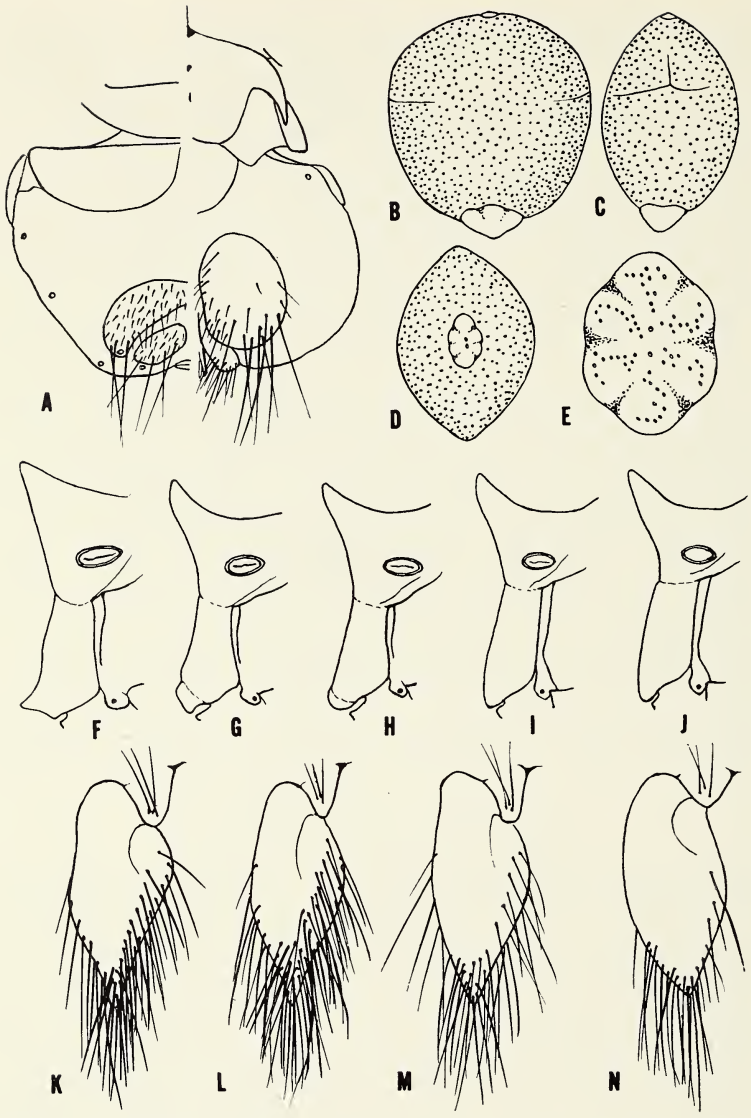

Fig. 50. **A**, *Stilbometopa legtersi* J. Bequaert, abdomen and hind part of thorax dorsally and ventrally, ♂ allotype, San Ignacio, on *Ortalis c. canicollis;* setae shown on preäpical sclerites only. **B–E**, *Stilbometopa impressa* (Bigot), puparium from above (**B**), from the side (**C**), from the top (**D**), and peripneustic lobes (**E**). **F–J**, humeral callosities, anepisterna and notopleura of *Stilbometopa:* **F**, *S. impressa* (Bigot), ♀, Phoenix, on *Lophortyx g. gambelii;* **G**, *S. podopostyla* Speiser, ♀, Nova Teutonia, on *Chamaeza c. campanisona;* **H**,

hind corner of mesoscutum (near scutellum); apical scutellar comb of 40 to 48 stiff, long bristles, divided into 2 groups by a very short median interruption; transverse lateral ridge of mesosternum distinctly humped or tuberculate; prosternal lobes broadly rounded; metasternal spurs unusually strong, sharp, nearly straight. Legs as usual in the genus. Wing (Fig. 46*E*): venation differing little from that of *S. ramphastonis;* 2nd basal cell relatively long and narrow; a 7th longitudinal vein fairly distinct in the axillary cell. Abdomen (Fig. 48*D*): dorsally, partly fused basal 1st and 2nd pleurotergites unusually long, divided medially by an evenly rounded, narrow inward curve continued as a notch to near the base; two pairs of preänal dorsal sclerites; ventrally, basal sternite unusually large, semi-elliptical, about as long as wide, its surface strongly convex, bare and shiny; pair of preäpical sternites as usual. Head and thorax mostly very dark mahogany-brown to black; patches on face, sides of thorax and scutellum, pleurotergal processes, antennae and legs pale dirty-yellow. Membrane of wing hyaline; veins very pale dirty-yellowish.

Length of holotype, from tips of antennal appendages to hind margin of scutellum, 4.2 mm.; of wing, 6.5 mm.; width of wing, 2.3 mm.; total length of specimen in alcohol, 6 mm. The ♀ paratype from Argentina is slightly larger, the wing being 7.2 mm. long.

Male. Agrees with the female as described above, except as follows. Two vertical bristles in allotype, one much shorter and weaker than the other (one only in ♂ paratype). Median inward curve of occipital margin somewhat shallower than in ♀. Postvertex about as long as mediovertex, with a very light, median, linear depression over anterior two-thirds, but without pit. Lunula divided from interantennal area of frons at sides only by a deep suture. Appendage of 2nd antennal segment slightly narrower than in ♀, but of the same shape. Suture between notopleuron and prescutum complete and deep throughout. Abdomen (Fig. 50*A*): dorsally, as in ♀, but preäpical sclerites larger, those in 1st pair partly fused medially; ventrally, basal sternite relatively shorter than in ♀, though longer than usual in the genus, very convex and bare; pair of flattened or slightly concave sternites basad of terminalia large, almost halfmoon-shaped, bristly near edges, almost bare and shiny

S. fulvifrons (Walker), ♂, Holguin, on pigeon; **I**, *S. ramphastonis* Ferris, ♀, Turrialba, on wild pigeon; **J**, *S. legtersi* J. Bequaert, ♂ paratype, Chapada. **K–N**, antennae of *Stilbometopa:* **K**, *S. podopostyla* Speiser, ♂, San Bernardino; **L**, *S. fulvifrons* (Walker), ♀, Demarest, on *Hylocichla mustelina;* **M**, *S. ramphastonis* Ferris, ♀, Sto Thomas, Izabal, on *Ramphastos* sp.; **N**, *S. legtersi,* ♀ paratype, San Ignacio, on *Ortalis c. canicollis.*

in center. Terminalia protruding from tip of abdomen, not differing appreciably from those of *S. impressa* or *S. ramphastonis.*

Length of allotype, from tip of antennal appendages to hind margin of scutellum, 4.3 mm.; of wing, 7.5 mm.; width of wing, 2.3 mm.; total length in alcohol, 4.6 mm. The ♂ paratype (pinned) is slightly smaller, 4 mm. long to hind margin of scutellum, the wing 6.7 mm. long.

Mexico: Xocempich, 10 miles from Chichen-Itzá, Yucatán, female holotype, without host (D.B. Legters); Pesquería La Gloria, Arriaga, State Chiapas, Dec. 11, 1951, ♀ paratype, on *Ortalis vetula poliocephala* (M. Alvarez del Toro).

Brazil: Chapada, State of Matto Grosso, male paratype, without host.

Argentina: San Ignacio, Dept. Anta, Prov. Salta, female paratype and male allotype, taken together on "charata," *Ortalis c. canicollis,* Dec. 1953 (S. Pierotti. — Received from Dr. K.J. Hayward).

Holotype ♀ and paratypes ♀♂ at Mus.Comp.Zool., Cambridge, Mass.; allotype ♂ and paratype ♀ at Fundación Miguel Lillo, Tucumán, Argentina.

S. legtersi is possibly a specific parasite of game birds (Galliformes) of the family Cracidae, as suggested by the two captures on *Ortalis.* I suspect that the *Stilbometopa* reported by Travassos and Teixeira de Freitas (1941) from *Ortalis canicollis pantanalensis* was also *S. legtersi.* When I saw this fly some time ago, I called it *S. ramphastonis,* not realizing that it might have been a related, new species; it is not now available for study.

Affinities. *S. legtersi* is extremely close to *S. ramphastonis,* the distinctive features being indicated in the key.

Lynchia Weyenbergh, 1881

Lynchia Weyenbergh, 1881, An. Soc. Cientif. Argentina, **11**, pt. 5, p. 195 (monotypic for *Lynchia penelopes* Weyenbergh, 1881). Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 155 (in part only; includes also species of *Olfersia* and *Pseudolynchia*). J. Bequaert, 1926, Psyche, **32**, (for 1925), p. 266.

Lynchea Szidat, 1940, Zeitschr. f. Parasitenk., **11**, pt. 4, p. 579 (in the combination *Lynchea ardeae;* error for *Lynchia*).

Olfersia Macquart, 1835, Hist. Nat. Ins. Dipt., **2**, p. 640 (includes only *O. ardeae* Macquart, *O. longipalpis* Macquart, *O. fuscipennis* Macquart, and *O. americana* Leach, all of which are now placed in *Lynchia*). Schiner, 1864, Fauna Austriaca, Die Fliegen (Diptera), **2**, p. 645 (first description recognizable as that of the present *Lynchia;* included only *O. ardeae*). Not *Olfersia* Wiedemann, 1830, according to Coquillett's type designation.

Alfersia Schiner, 1853, Verh. Zool. Bot. Ver. Wien, **3**, Abh., pp. 153 and 154 (error for *Olfersia;* in the combination *Alfersia ardeae*).

Ornithophila Rondani, 1879, Boll. Soc. Ent. Italiana, **11**, pp. 11 and 20 (monotypic for *Ornithophila vagans* Rondani, 1879, of Italy).
Icosta Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 358 (monotypic for *Olfersia dioxyrrhina* Speiser, 1904).
Ornithoponus Aldrich, 1923, Insecutor Inscitiae Menstruus, **11**, pp. 73 and 77 (substitute for *Olfersia* Macquart, with description. Type by original designation: *Feronia americana* Leach, 1817).
Ornitomyia Dugès, 1887, La Naturaleza, Mexico, (2), **1**, pt. 1, p. 18 (evidently an error for *Ornithomyia*, but used only in the combination *Ornitomyia villadae* Dugès, which is a *Lynchia*).
Lynechia Maliandi, 1943, Rev. Med. Veter., Buenos Aires, **25**, p. 127 (error for *Lynchia*).

Generic Characters. Fully-winged parasites of birds, sometimes with metallic-greenish sheen on head and thorax, never with dull-green haemolymph. Head inserted between the prominent humeral callosities; occiput extending over anterior margin of notum. Ocelli lacking in most species, rudimentary or present but very small in a few; position of median ocellus often indicated by a small pit. Eyes large, with many minute but well-defined ommatidia. Postvertex and frons far apart; intervening soft mediovertex much longer than either. Occipital margin usually almost straight, exceptionally slightly wavy. Frons divided by a deep, straight, transverse suture into a broad upper lunula (sometimes with a median pit or depression) and a much narrower interantennal portion (frontal carina); the latter consists of a short base followed by two long to very long (often prong-like) pointed, diverging apical arms, strongly sclerotized throughout. Antennae medium-sized; 1st segment bearing a few setae, either completely divided by a suture from the lunula (as in *L. hirsuta*, Fig. 66*C*) or with only traces of a suture at sides (as in *L. albipennis*, Fig. 5*A*); 2nd segment with a short, broadly rounded, very bristly appendage, not extending beyond lower margin of antennal pit, with a long apical, dorso-lateral slit near outer margin; arista ending in a long narrow, transparent spatula (as in *Pseudolynchia canariensis*, Fig. 11*F*). Palpi of variable length. Pronotum very short, in dorsal view hidden by occipital margin. Humeral callosities large but rather short, produced forward as broad, bluntly pointed lobes set off from prescutum by shallow grooves; posthumeral suture very short, deep, developed only near anepisternum; prothoracic spiracle usually long and narrow, often partly hidden, placed in dorsal hind margin of callosity; sometimes much larger and then in a more forward position. Anterior margin of prescutum as a rule nearly straight, rarely somewhat wavy; transverse mesonotal suture deep, straight, not or narrowly interrupted medially, usually before hind third of mesonotum; postalar callus fused with mesoscutum; median notal suture well marked

throughout; notopleuron completely fused with prescutum, only the hind corner, bearing one or (rarely) 2 notopleural bristles, set off by a depression or sometimes tuberculate. Dorsal portion of anepisternum broad, lathe-shaped, slightly wider posteriorly, with blunt, scarcely projecting outer hind edge. Scutellum large, semi-elliptical, with convexly curved hind margin; surface scarcely raised, with a slight antero-median, triangular, rugulose depression which continues behind as a linear groove; scuto-scutellar suture very deep, narrowly interrupted at extreme sides. Pleurotergite of metathorax low, transverse, slightly convex, without process. Presternum very short; pro-basisternum fused with mesosternum; broad area between fore coxae usually forming slight, blunt lateral ridges close to coxae, the intervening anterior margin nearly straight; in some species edges of prosternum more lobe-like and separated by a deeper, concave area; mesosternum and meta-basisternum separated by a broadly V-shaped suture forming medially a blunt forward angle in a deep furcal pit; outer hind margin of meta-basisternum usually rounded off, exceptionally produced as a meta-sternal tooth over base of hind coxa (in *L. bicorna* Ferris and 1 or 2 African species); metasternum divided into a basisternum and a furcasternum by a suture, which is deep and sharply triangular medially, elsewhere sometimes superficial; meta-furcasternum undivided, its hind margin straight or shallowly concave; a median sternal suture over pro-basisternum, mesosternum and meta-basisternum. Metathoracic spiracle placed immediately behind and below the pleurotergite, between halter and hind coxa. Legs usually long, rather slender; femora barely swollen; tibiae flattened; tarsal segments 1 to 4 broad, short, those of fore legs sometimes asymmetrical, the 4th segment being thumb-like at apex on one side; hind basitarsus much lengthened, without transverse comb of setae beneath; tips of tibiae normal; tibial spurs weak, bristle-like. Claw divided to near base into two long, slender teeth, the outer one very sharp, the inner one slightly shorter and blunter; basal "heel" also narrow, tooth-like, but shorter than the true teeth (claw seemingly tridentate); empodium and 2 pulvilli present. Wing usually large; venation (Fig. 14*F*) incomplete, without posterior basal (or anal) cross-vein; anterior basal cross-vein placed much basad of anterior cross-vein; 2nd basal cell much shorter than 1st; 1st to 3rd longitudinal veins ending in costa at sharp angles; subcosta complete or incomplete (not reaching costa); 2nd longitudinal free throughout, ending in costa closer to tip of 3rd than of 1st; bullae extensive in basal elbow of 4th longitudinal and particularly in anterior basal

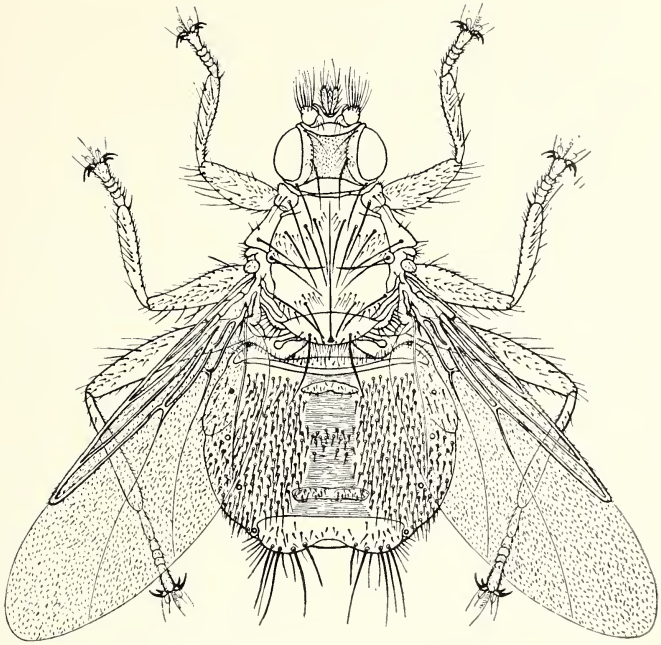

Fig. 51. *Lynchia hirsuta* Ferris, ♀, Jolon, on *Lophortyx c. californica.* × about 10.

cross-vein (which may seem almost effaced); costa setulose; all other veins bare; membrane covered partly or mostly with microtrichia, the area covered being characteristic for each species; alula usually very narrow or rudimentary, sclerotized throughout, rarely (as in *L. hirsuta*) wider and membranous; calypteres almost reduced to the thickened setulose margin, the distal one the larger and set off by notches from both the proximal one and the alula; proximal calypter a narrow semi-membranous ledge continuous with the posterior ridge of the parascutellum. Dorsum of abdomen with the usual comparatively short basal two pleurites fused and continuous across the middle; often in addition one or more small median sclerites (sometimes lacking, as in *L. nigra*); a large, transverse preänal sclerite, often partly divided by a median depression or by wavy margins; middle of dorsum a continuous, somewhat sclerotized, shiny area, closely covered with very fine transverse striae. Seven pairs of abdominal spiracles as follows: 1st close to insertion of abdomen, in ventral edge of 1st pleurite; 2nd close to antero-lateral edge of 2nd pleurite, usually somewhat ventrally; 3rd, 4th and 5th

dorso-lateral, free in the membranous integument; 6th also dorso-lateral, but very near or even within outer edge of large preänal sclerite; 7th ventral, some distance from side of anal opening; the dorsal or ventral position of the spiracles may shift as the abdomen expands or contracts. Body as a rule moderately hairy, rarely more hirsute (mesonotum entirely setulose in the African *L. pilosa* Macquart); chaetotaxy variable according to the species; usually only one vertical bristle at hind corner of upper orbit. Scutellum with only one long disco-scutellar bristle on each side, a preäpical row of short, weak bristles, and an apical fringe of soft, hair-like setae; metathoracic pleurotergite setulose; sternum almost bare. Abdomen usually with fewer setae over median striate dorsal area than elsewhere. Prescutum and mesoscutum shiny, but with a fine, regular striation of engraved lines radiating from the humeral callosities, on a slant anteriorly and longitudinal elsewhere.

The male terminalia proper seem to be reduced in *Lynchia* to the aedeagus (penis and 2 penis valves), the gonocoxites being lost; instead each lateral area of the genital atrium is enlarged into a flap or lobe densely covered with stiff setulae (*setigerous lobe, slo,* Figs. 52*G* and 63*G*). The two lobes may be folded over the genital atrium or spread out sideways (Figs. 62 and 65). They could readily be mistaken for gonocoxites; but they appear to be homologous with the flat, partly setulose areas at the sides of the terminalia proper in *Ornithomyia* and *Ornithoctona* (Figs. 29*C* and 38*D–E*). Moreover, in certain *Lynchia,* such as *L. albipennis* (Fig. 63*G*), vestiges of the true gonocoxites seem to be present as minute tubercles bearing one seta, one on each side in the corner between the setigerous lobe and the base of the aedeagus (*GCO,* in Fig. 63*G*). The female genital atrium shows no peculiarities (Figs. 52*F* and 70*B*).

The presence in the wing of only the anterior and anterior basal cross-veins is a striking characteristic of *Lynchia,* which it shares with *Olfersia.* This involves, however, more than the mere loss of the posterior basal cross-vein, since at the same time the 6th longitudinal vein is greatly reduced or almost lost (Fig. 63*A*). Consequently the large cell (*AN+*) behind the 5th longitudinal vein consists not only of the combined anal and 3rd posterior cells, but includes also the axillary cell and is therefore limited behind by the axillary vein, more than usually developed. The cell at the basal hind border of the wing is a *postaxillary cell* (*PAX*). A vestige of the 6th longitudinal vein usually remains as a short, partly discolored and gradually fading stump at the lower basal angle of the

2nd basal cell. The stump is sometimes very weak except at the base (*L. hirsuta*, Fig. 66*G*) or barely visible. *Microlynchia, Pseudolynchia* and *Olfersia,* all of which have lost the posterior basal cross-vein, have the 6th longitudinal similarly reduced to a stump, which is often difficult to trace in *Olfersia.* This arrangement is possibly foreshadowed in *Stilbometopa* (Figs. 46*A–E* and 47*C*), where the basal section of the vein has a distinct break at about mid-length of the hind margin of the anal cell, beyond which the vein tends to be very weak.

The name *Lynchia* has been used in various ways, not only for species here included, but also for others properly placed in *Olfersia, Pseudolynchia* and *Microlynchia.* It is now restricted to the species, including the genotype, agreeing with the generic characters given above. Some of the synonyms listed are either misspellings or due to erroneous interpretations of the genotype (*Olfersia; Ornithoponus*). Only the following two names should be discussed.

Rondani's diagnosis of *Ornithophila* is as follows: "Antennae laminiformes margine pilis longis ciliato. Proboscis basi crassiuscula, a palpis brevibus partim tecta, lingua (in specim. nostro) satis longa filiforme. Frons ocellis tribus setigeris instructa. Alae completae, ad apicem rotundatae, non angustatae, abdomine longiores, margine antico sub-nudo; venis costalibus tribus tantum distinctis, satis proximis; areola axillare nulla, inde venis duabus tantum transversis, quarum interior valde distat ab exteriore. Abdomen parvum, lateribus ad basim productis. Scutellum margine postico in medio piligero. Pedes setulosi et pilosuli, tarsis uncos validis trifidis ferentibus." The genotype, *Ornithophila vagans* Rondani, was found near Parma, Italy, the host being unknown; no other specimen was ever recognized. The type has not been studied again, although Dr. B. Lanza informs me (*in litt.,* 1953) that it is preserved in Rondani's collection, at the Museum in Florence. Until it can be examined critically, it can only be interpreted from the description and Rondani's sketch of a wing. These agree with *Lynchia* in every respect save for the presence of ocelli. On the same evidence, Austen (1903, p. 263) referred *Ornithomyia simplex* Walker, from Celebes, to *Ornithophila.* I have reached the same conclusion after a recent (1951) examination of Walker's type. *Ornithophila maquilingensis* Ferris (1924*a*, p. 392), also from the Malay Archipelago, may be identical with *simplex* and is certainly congeneric. A study of these and other similar Malayan specimens has failed to show any character except the presence of ocelli separating them from the usual species of *Lynchia.* Moreover, at least

two other species of *Lynchia,* one African (undescribed) and the other South American (*L. plaumanni*), show either rudimentary or more or less developed ocelli, although they have all the other characters of the genus. As these ocelligerous species share no other character which might group them, evidently the sporadic occurrence of ocelli is not of supra-specific significance in this case. *Ornithophila* is not even entitled to subgeneric rank.

Icosta Speiser was proposed with the following diagnosis (translated from the German:) "Hippoboscids with lengthened basal knob ['heel'] and accessory tooth on claws, without ocelli, without anal cross-vein; anterior basal cross-vein ['hintere Querader'] present. Clypeus [frons] from ptilinal suture ['Stirnspalte'] to tips of lateral arms as long as the distance between ptilinal suture and occiput ['Scheitel'], but deeply emarginate at anterior margin, so that it is only short in the middle and forms two lateral, sharp points. Occiput ['Scheitel'] wavy and produced backward in the middle, next to which it is somewhat retracted, the anterior margin of the thorax having three corresponding inward curves side by side." In the earlier specific description of the genotype, *Lynchia dioxyrhina,* Speiser (1904*d*, p. 387) stated that the hind margin of the occiput and the anterior margin of the thorax were wavy, with 3 inward curves, similar to those of *Olfersia spinifera* (Leach). This and the other characters mentioned by Speiser are not, however, of more than specific value in Hippoboscidae. While the apical frontal arms are perhaps unusually long in *L. dioxyrhina,* they are prong-like in several other *Lynchia* (*L. bicorna* Ferris; *L. chalcolampra* Speiser = *L. pollicipes* Ferris; and 2 or 3 undescribed African species), while in others (*L. samoana* Ferris, for instance) they are transitional to the more normal, short condition. This peculiarity is, moreover, not correlated with any other that might be used to set off a distinct supra-specific group. It seems unnecessary to retain *Icosta* even as a subgenus.

Lynchia is cosmopolitan and the largest genus of Hippoboscidae, with some 35 presumably valid described species and a few as yet undescribed. Of the 10 American species here discussed, one, *L. penelopes,* has not been recognized since the original description, and 2, *L. nigra* and *L. albipennis,* occur also in the Old World.

Lynchia rottensis (Statz), the only known fossil hippoboscid, was discussed before (Part II, pp. 39–41). According to a recent notice (1955, *Bull. So. California Ac. Sci.,* **54,** pt. 2, p. 104), the Statz Collection, containing this fossil, is now at the Los Angeles County Museum, Los Angeles, California.

Key to American Species of *Lynchia*

The characters selected for the key are those which I have found most reliable for the recognition of the species. It would be convenient to have a primary division into large species (*L. americana, L. wolcotti* and *L. nigra*), with the wing 7 to 9 mm. long, and small species (most of the remaining American forms), with the wing 6 mm. long or less. Unfortunately one species, *L. latifacies*, with a wing 6 to 7 mm. long, connects the two groups. Moreover, the large species sometimes produce dwarfed specimens which may lead astray. Size, although constant within fairly narrow limits for each species, does, of course, not express true kinship. It is possible that certain species here treated as distinct mainly on the basis of size, such as *L. wolcotti* and *L. angustifrons*, may eventually prove to be only large and small races of the same thing. The extent of the area covered with microtrichia in the wing varies within narrow limits and I regard it as a most reliable character. On the other hand I do not trust minor differences in the venation, so often mentioned because they are obvious. In particular, the positions on the costa of the tips of the subcosta, 1st, 2nd and 3rd longitudinal veins, in relation either to one another or to the cross-veins, are too variable intraspecifically to be trusted. Whether the subcosta is complete (ending in the costa) or incomplete (stopping in the membrane before reaching the costa) is most variable, as I show in discussing the several species. While in most species one or the other of the two conditions prevails or is constant, it is of doubtful value in a key. Color characters are not mentioned, as I regard them as worthless. *L. penelopes*, at present unrecognized, is not included in the key.

1. Interocular face narrow, at its narrowest not or scarcely wider than an eye, at its widest (at postvertex) narrower than the height of an eye. Orbital bristles few, in one row. Palpi about as long as $\frac{1}{2}$ the height of head (from occipital margin to base of palpi). Hind $\frac{1}{3}$ to $\frac{1}{2}$ of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia 2

   Interocular face wide, at its narrowest much wider than an eye, at its widest (at postvertex) as wide as or wider than the height of an eye 3

2. Large species; wing 7 to 8 mm. long ..... *L. wolcotti*

   Small species; wing 5 to 6 mm. long ..... *L. angustifrons*

3. Prescutum with 3 long, erect, stiff bristles in each of the lateral patches of soft, appressed setae. Orbital bristles many, in

more than one row in upper half of orbit. Combined anal, 3rd posterior and axillary cells almost completely covered with microtrichia, but entire postaxillary cell bare. Small species; wing 4.5 to 5.5 mm. long ..... *L. hirsuta*

Prescutum without long, erect, stiff bristles in the lateral patches of appressed setae 4

4. Orbital bristles many, in more than one row 5

Orbital bristles few, in one, sometimes irregular row 7

5. Large species; wing 7.5 to 9 mm. long. Interocular face at its widest about twice as wide as an eye. Palpi nearly as long as $\frac{1}{2}$ the height of head (from occipital margin to base of palpi). Hind $\frac{1}{3}$ to $\frac{1}{2}$ of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia. Lateral patches of appressed setae on prescutum extensive ..... *L. nigra*

Small species; wing 4.5 to 6 mm. long. Palpi much shorter than $\frac{1}{2}$ the height of head (from occipital margin to base of palpi). Combined anal, 3rd posterior and axillary cells completely or nearly completely covered with microtrichia. Lateral patches of appressed setae on prescutum small 6

6. Interocular face at its widest (at postvertex) nearly 3 times as wide as an eye (in ♀; ♂ unknown). Postvertex nearly as long as mediovertex. Occipital margin strongly arched. Postaxillary cell covered with microtrichia except for a very narrow bare hind border. Wing 4.6 to 5 mm. long. *L. holoptera*

Interocular face at its widest (at postvertex) less than 3 times as wide as an eye (in both sexes). Postvertex much shorter than mediovertex. Occipital margin slightly arched medially. Hind half or more of postaxillary cell without microtrichia. Wing 4.5 to 6 mm. long ..... *L. albipennis*

7. Basal hind area only of combined anal, 3rd posterior and axillary cells, as well as most of postaxillary cell, without microtrichia. Postvertex often with vestigial ocelli. Palpi at most as long as $\frac{1}{2}$ the height of head (from occipital margin to base of palpi). Small species; wing 5.5 mm. long. *L. plaumanni*

Hind $\frac{1}{3}$ to $\frac{1}{2}$ of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia. No vestigial ocelli 8

8. Palpi about as long as $\frac{1}{2}$ the height of head (from occipital margin to base of palpi). Frons with moderately long

apical arms, the undivided base of the interantennal portion narrower than its distance from an eye. Large species; wing 7 to 8.5 mm. long ..... *L. americana*

Palpi decidedly longer than ½ the height of head (from occipical margin to base of palpi). Frons with moderately long apical arms, the undivided base of the interantennal portion about as wide as its distance from an eye. Medium-sized species; wing 5.8 to 7 mm. long ..... *L. latifacies*

Lynchia penelopes Weyenbergh

Lynchia penelopes Weyenbergh, 1881, An. Soc. Cientif. Argentina, **11**, pt. 5, p. 199 (♀ ♂; on "pavo del monte, yacú or charate, *Penelope canicollis*" [*Ortalis c. canicollis*]. Argentina: Province Tucumán. Types lost). Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 155. Brèthes, 1907, An. Mus. Nac. Buenos Aires, **16**, p. 302. Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. J. Bequaert, 1926, Psyche, **32**, (for 1925), pt. 6, p. 270 (translation of original description); 1945, *Op. cit.*, **52**, p. 103.

The following is the original description of the genus *Lynchia* and of the species *penelopes* (Spanish text translated). All structural characters were in the account of the genus, the description of the species mentioning only color and size. "Antennae gemmiformes elongatae setosae, lateribus hipostomatis insertae. Ocelli nulli. Tarsi unguibus tridentatis. Alae late incumbentes abdomine multo longiores, acuminatae. This genus must be placed between *Ornithomyia* and *Olfersia*. Although the antennae are button-shaped, they are longer than in *Ornithomyia* and hairy, especially at the tips, and are inserted very low down. The two compound eyes are very globular [bulging] and leave between them a wide frons [interocular face]; but there are no simple eyes [ocelli], instead of which the spot which usually bears them forms a small, dusky, somewhat raised plate [postvertex]. This lack of ocelli removes the genus from *Ornithomyia* and brings it near *Olfersia*. The tridentate claws, on the other hand, place it near the former and farther from the latter.[38] The wings are on the whole similar to those of *Ornithomyia* and *Olfersia*, but in the latter they are much rounded off at apex and they are also quite obtuse in the former; while in *Lynchia* they are very pointed, but at the same time very long. The head is flat, disk-shaped, as in the genera mentioned, which it also resembles in its articulation on the thorax and general appearance. The mouth-parts are very short and completely hidden within the short surrounding sheath [palpi]. The line or transverse suture, dividing the thorax into two [transverse mesonotal suture], is very distinct; but the longitudinal line [median notal suture], which is furrow-like in the other genera, is much raised in *Lynchia*, even forming a narrow ridge. The outer angle of the thorax bears an ovate spiracle, with several stiff setae on the anterior margin. Scutellum very short and broad. Abdomen with strong spines on the side margins of the segments and long setae at apex. Legs sparsely hairy, with only a few stronger setae near the claws. The venation is characteristic, though somewhat similar to that of *Ornithomyia;* but the differences outweigh the similarities. Only three veins run from the articulation to the lower [hind] margin of the wing. As in *Ornithomyia*, the veins are dark colored in the area near the anterior margin and the articulation

[38] The structure of the claws is the same in *Ornithomyia, Olfersia* and *Lynchia*. Actually each true claw is deeply bifid or bidentate, but the elongate basal heel makes it appear tridentate.

[base], as if the hollow veins were filled with opaque matter; while elsewhere the veins are delicate and hyaline. I noticed the following peculiarity of *Lynchia* in this connection: the discoidal vein [4th longitudinal] is always broken by a clear and transparent stretch, a short distance beyond the fork of the common posterior [stem-vein] into the discoidal [4th longitudinal] and the true posterior [5th longitudinal]. At first the vein seems actually interrupted there, but correct focusing proves that the break is not in the vein itself but in the substance filling the vein. I supposed originally that this was an accidental abnormality, but I now regard it as a constant feature. The costal vein [1st and 2nd sections of costa] is very short, not extending beyond one-third of the wing, where the subcostal [1st longitudinal] unites with it and then forms one-third more of the anterior margin, to the junction of the radial [2nd longitudinal] and subcostal. The mediastinal [subcosta] almost touches the subcostal [1st longitudinal], the space between them being very narrow. The transverso-basal [humeral cross-vein] is present, but is outwardly slanted between the costal [costa] and subcostal [1st longitudinal], basad of the origin of the mediastinal [subcosta] from the subcostal [1st longitudinal]. The first longitudinal [base of 2nd and 3rd longitudinals] bifurcates into the radial [2nd longitudinal] and the cubital [3rd longitudinal] very close to its own origin. The radial [2nd longitudinal] runs toward the anterior margin, where it continues for some distance as the continuation of the subcostal [1st longitudinal] and soon unites at a sharp angle with the cubital [3rd longitudinal], also in the anterior margin; the junction lies at about two-thirds of the length of the anterior margin. Along the remainder of the margin there is no vein. The second longitudinal or common posterior [stem-vein of 4th and 5th longitudinals] bifurcates almost at once beyond its origin, forming the discoidal [4th longitudinal] and true posterior [5th longitudinal]). The discoidal [4th longitudinal] runs at first somewhat toward hind margin, then bends toward the anterior margin, so that the first articular cell [1st basal cell], between the cubital [3rd longitudinal] and discoidal [4th longitudinal] and closed by the transverso-media [anterior cross-vein], is very angular outwardly. The discoidal [4th longitudinal] is connected with the cubital [3rd longitudinal] by the transverso-media [anterior cross-vein] at about two-thirds of the length of the cubital [3rd longitudinal], beyond which the discoidal [4th longitudinal] gradually curves toward hind margin of wing, where it ends at about apical fourth. The other branch or true posterior [5th longitudinal] also curves gently toward the same margin, where it ends at about mid-length. The transverso-discoidal [anterior basal cross-vein] reaches the discoidal [4th longitudinal] at the above-mentioned bend of this vein, to form the discoidal cell [2nd basal cell]. There are no transverso-posterior veins [anal and discoidal cross-veins]. The anal vein [6th longitudinal] has a double origin, is strongly curved toward the hind margin and stops at about three-quarters of the margin, as measured from the tip of the wing. The several veins of what I call the anterior system are crowded near the anterior margin, the cells and spaces between the veins being very long and narrow. Only the three posterior and the axillary cells are large and wide. The crowding of veins near the anterior margin is also seen in *Ornithomyia* but not as marked as in *Lynchia,* so that the cells between them are not so long and narrow. *Ornithomyia* also differs in lacking a mediastinal [subcosta], which is fused with the subcostal [1st longitudinal].[39] The transverso-basal [humeral cross-vein] is more perpendicular in *Ornithomyia.* It appears that in that genus an incomplete vein starts from the

[39] This is erroneous. The subcosta (or mediastinal) is present in *Ornithomyia* as well as in *Lynchia* and most other genera of Hippoboscidae. I have inserted in brackets my own terminology of the wing venation.

point where the cubital [3rd longitudinal] ends in the anterior margin, and forms a strong curve toward the tip of the wing, cutting off part of the first posterior cell, but incompletely, since this rudiment of vein does not reach the margin itself. It also seems that in *Ornithomyia* the anterior margin is bordered by a vein to within a short distance of the tip, a feature not seen in *Lynchia*.[40] In addition *Ornithomyia* has a first transverso-posterior vein placed about opposite the transverso-discoidal [anterior basal cross-vein], which it appears to extend forming with it an S-shaped figure; this feature especially produces an important difference in that part of the wing when comparing the two genera.[41] In *Ornithomyia* there also seems to be a second transverso-posterior vein [anal cross-vein], very near the articulation [basally], connecting the anal [6th longitudinal] and the posterior [5th longitudinal], immediately beyond the forking of common posterior [stem-vein] into the discoidal [4th longitudinal] and the true posterior [5th longitudinal]. As I mentioned, this cross-vein is entirely lacking in *Lynchia*. Tarsi as usual in the family; halteres as in *Ornithomyia*.'' The specific description is as follows: ''*L.* sepia-obscura, oculis subfuscis margine orbitali piceo. Antennae flavescentes extremo orbitali obscuro. Frons flavescens. Alae hyalinae. Femora anteriora aurata. The eyes are dark reddish-brown, and an orbital, nearly black half-circle surrounds them on the frontal portion [inner orbits]. The eyes are large and spherical ['esféricos,' meaning bulging or convex], with punctiform facets. The antennae and the frons [mediovertex] are yellowish and the top of the occiput bears a triangular, dusky, somewhat raised plate [postvertex]. Labrum [frons] with a dark spot. Tip of first antennal segment [really 2nd segment] also nearly black. Thorax dark sepia; median raised line [median notal suture] brownish-black; entire thorax with a yellowish sheen, somewhat metallic, especially on the metathorax and along the margins of the scutellum, the latter bearing hairs at the hind border. Abdominal segments of the same color, very dark, their margins with a yellowish tinge at the articulations. Veins of the same general color, a little grayish, the wings very transparent and large. Halteres dirty-white. Claws of legs black; tarsal segments dark-brown, somewhat paler in the middle. Femora flat, yellowish, with nearly black upper margin, the flattened sides yellowish; tibiae of hind legs entirely dark or dark-brown. Femora of fore legs golden-yellow beneath. Articulations of all legs dark. Under side very shiny, dark sepia, metal-

[40] No specimen of *Ornithomyia* or any other hippoboscid I have seen shows the incomplete vein curving off from the tip of the 3rd longitudinal, or the extension of the costal vein to near the tip of the wing as described by Weyenbergh. This author was misled by Meigen's defective figure of the wing of *Ornithomyia*. In *Ornithomyia* the apex of the 1st posterior cell bears microtrichia on both sides of the membrane and this area is sometimes set off by a curved crease simulating a spurious vein.

[41] Weyenbergh used for comparison a drawing of the wing of *Ornithomyia* by Meigen (1830, **6**, Pl. 64), which explains some of his erroneous interpretations. He failed to note that the ''first transverso-posterior vein'' which he described in *Ornithomyia* corresponds to what he called the ''transverso-discoidal'' in *Lynchia*, the second basal cell being so long in *Ornithomyia* that the anterior cross-vein and the anterior basal cross-vein are close together; in *Lynchia* these two cross-veins are far apart.

lic. Labium [gula] pale brown; genitalia yellowish. Venter finely granulose or shagreened, particularly in the female. The break in the discoidal vein [4th longitudinal], mentioned in the generic description, is possibly a specific character only; but it seems to be constant. Spread of wings, from one wing tip to the other, 2.5 cm. Length, including the head, but not the wings, 1 cm. in ♀, 8 mm. in ♂.''

The species has not been recognized since the description, which is most unfortunate, inasmuch as it is the type of the genus *Lynchia*. The original specimens are almost certainly lost, all efforts to trace them having failed. The detailed generic diagnosis, however, leaves no doubt that *L. penelopes* is congeneric with the species now placed in *Lynchia;* but it should be realized that Weyenbergh misunderstood the venation of *Ornithomyia* in his comparison with that of *Lynchia*. *L. penelopes* lacked ocelli, had a short postvertex separated from the frons by a long mediovertex, and had 2 closed basal cells, but no closed anal cell. These features eliminate *Ornithoica, Ornithomyia, Ornithoctona, Stilbometopa, Olfersia, Pseudolynchia* and *Microlynchia*. If the measurements are to be trusted, *L. penelopes* was about the size of *Ornithoctona erythrocephala*, thus exceeding the 3 large species of *Lynchia* now recognized in South America, *L. americana, L. nigra* and *L. wolcotti*. While the description agrees fairly well with *L. nigra*, the discrepancy in size is too great to identify *L. penelopes* with it at present, particularly as *L. nigra* has not been recorded since from *Ortalis canicollis* or one of the Cracidae. It seems more probable that the Cracidae of Argentina harbor a peculiar, specific species of *Lynchia*, as the quail do in the western United States. Weyenbergh may have been uncertain about the specific identity of the host. He follows the vernaculars ''pavo del monte, yacú or charate'' with the Latin name ''*Penelope canicollis.*'' Dr. K. J. Hayward points out (*in litt.*, 1954) that only ''charata'' (not ''charate'') is used in Argentina for the gray-headed chachalaca, *Ortalis c. canicollis;* while ''pava del monte'' refers there to several species of guan (*Penelope*), the dusky guan, *Penelope o. obscura*, being also called ''yacú.'' All these species of Cracidae should therefore be investigated as possible hosts of *L. penelopes*. Two flies from *Ortalis c. canicollis*, recently sent to me by Dr. Hayward, proved to be *Stilbometopa legtersi*, described above.

Lynchia americana (Leach)

Figs. 14*F*, 52*A–G*, 53*A–P*, 54 and 55

Feronia americana Leach, 1817, Gen. Spec. Eproboscideous Ins., pp. 6 and 11; Pl. 27, figs. 1–3 (no sex; no host. Georgia. Type ♀ at Brit. Mus.) [1818, Mem. Werner. Nat. Hist. Soc., Edinburgh, **2**, pp. 552 and 557; Pl. 27, figs. 1–3]. Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 264 (type). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 188.

Olfersia americana Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 606. Harris, 1835, in Hitchcock, Rept. Geol. Miner. Zool. Bot. Massachusetts, 2nd Ed., p. 600 (Massachusetts). Macquart, 1835, Hist. Nat. Ins. Dipt., **2**, p. 641. Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1141 (Ontario: Martin Fall on Albany River, 51° 33′ N., 86° 33′ W.). Osten Sacken, 1858, Cat. Dipt. North America, p. 86. van der Wulp, 1867, Tijdschr. v. Entom., **10**, p. 128 (Wisconsin). Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 213 (Illinois. Texas: Dallas, on *Bubo v. virginianus* and *Buteo jamaicensis borealis*. Synonymizes with it *Hippobosca bubonis* Packard). Brodie and White, 1883, Check list Ins. Dom. Canada, p. 57. Howard, 1883, South Carolina, Resources and Population, p. 275 (South Carolina). Johnson, 1895, Proc. Ac. Nat. Sci. Philadelphia, p. 340 (Florida: St. Augustine, on *Otus asio floridanus*). Elliott, 1899, 29th Rept. Ent. Soc. Ontario, (for 1898), p. 59 (Ontario: Bryanton, on

Buteo p. platypterus). Johnson, 1900, 27th Rept. New Jersey Bd. Agric., (for 1899), Suppl., p. 699 (New Jersey: Haddenfield, on *Buteo jamaicensis borealis*). Howard, 1901, The Insect Book, p. 188, fig. 109 (after Packard, 1869). Aldrich, 1905, Smithson. Misc. Coll., **46,** No. 1444, p. 655. Kellogg, 1905, American Insects, p. 35 (same in 2nd Ed., 1908). Washburn, 1905, Univ. Minnesota, Agric. Expt. Sta., Bull. **93,** p. 163 (Minnesota: on *Strix v. varia*). Speiser, 1907, Ent. News, **18,** p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4,** p. 304. Johnson, 1910, Ann. Rept. New Jersey State Mus., (for 1909), p. 814; 1913, Bull. Amer. Mus. Nat. Hist., **32,** p. 90 (Florida: Miami). Swenk, 1916, Jl. New York Ent. Soc., **24,** pp. 130 and 132 (synonymizes with it *Hippobosca bubonis* Packard. Nebraska: Brownville, on *Bubo v. virginianus;* Westpoint, on *Buteo lagopus sancti-johannis.* Kentucky: Louisville). McIndoo, 1918, Jl. Compar. Neurology, **29,** p. 468 (sense organs of wings). Lutz, 1918, Field Book of Insects, p. 277; Pl. 71, fig. Britton, 1920, Connecticut Geol. Nat. Hist. Surv., Bull. **31,** p. 210 (Connecticut). Cole and Lovett, 1921, Proc. California Ac. Sci., (4), **11,** p. 344 (Oregon: Corvallis, on *Bubo virginianus saturatus*). Young, 1922, Cornell Univ., Agric. Expt. Sta., Mem. **44,** (for 1921), p. 261; Pl. 31, fig. 74; Pl. 32, fig. 75 (♀; morphology). Johnson, 1922, Psyche, **29,** p. 83 (Massachusetts: Wenham, on *Bubo v. virginianus* and *Buteo l. lineatus;* Dover; Framingham, on *Strix v. varia*; Sherborn. New Hampshire: Hampton, on *Asio wilsonianus.* Vermont: Dunmore Lake. Connecticut: Liberty Hill, on *Bonasa u. umbellus.* Illinois: on *Buteo jamaicensis borealis.* Texas: on *Buteo p. platypterus.* California: San José, on *Tyto alba pratincola.* Without locality, on *Falco c. columbarius* and *Otus asio mccallii*). Davis, 1922, Proc. Staten Island Inst. Arts Sci., **1,** p. 65 (New York: Freeport, on *Circus cyaneus hudsonius;* Yankee Lake, Wurtsboro, Sullivan Co., on *Buteo p. platypterus;* Staten Island). Ferris and Cole, 1922, Parasitology, **14,** pt. 2, p. 194, figs. 11–12 (Washington, D.C. California: San Bernardino, on *Tyto alba pratincola*). Herms, 1923, Medical Veterinary Entomology, 2nd Ed., p. 351. Champlain, 1923 (May), Forest and Stream, p. 279, fig. (no locality). J. H. Comstock, 1924, Introduction to Entomology, p. 875. Allen, 1927, American Game, **14,** p. 12 (on *Bonasa umbellus*). Cole, 1927, Proc. California Ac. Sci., (4), **16,** pp. 452 and 499, fig. 287 (abdominal spiracles; ♂ terminalia). Zebrowski, 1932, Audubon Yearbook, Indiana Audubon Soc., p. 48. Green and Shillinger, 1935, Minnesota Wildlife Dis. Investig., (1933–1934), (mimeographed), p. 73 (Minnesota: Pine Co., on *Bonasa umbellus*). Webber, 1950, in Craighead, Insect Enemies Eastern Forests, (U. S. Dept. Agric. Misc. Publ. **657**), (for 1949), p. 529.

Ornithoponus americanus Aldrich, 1923, Insecutor Inscitiae Menstruus, **11,** pp. 77 and 78. Johnson, 1925, Occ. Papers Boston Soc. Nat. Hist., **7,** p. 293 (Maine; New Hampshire; Vermont; Massachusetts; Connecticut); 1925, Proc. Boston Soc. Nat. Hist., **38,** p. 99 (Massachusetts: on *Buteo jamaicensis borealis,* in Harris Coll. South Carolina: Society Hill, on *Bubo v. virginianus*); 1925 Bull. Northeastern Bird-Banding Assoc., **1,** p. 52. Gross, 1925, The Auk, **42,** p. 431 (on *Bonasa u. umbellus* in New York and New England); 1926, Progress Rept. New England Ruffed Grouse Invest. Comm., [unnumbered p. 8]. Essig, 1926, Insects Western North America, p. 623. Johnson, 1927, Bull. Boston Soc. Nat. Hist., No. **42,** p. 15. Johannsen, 1928, in Leonard, Cornell Univ., Agric. Expt. Sta., Mem. **101,** (for 1926), p. 868 (New York: Buffalo; Hammondsport; Baldwinsville, on *Bubo v. virginianus;* Ithaca; Austerlitz, on *Bonasa u. umbellus;* Orient Point, Long Island, on *Buteo jamaicensis borealis*). Gross, 1931, New England Game Conference, p. 54 (Wisconsin: on *Pedioecetes phasianellus campestris*). Procter, 1938, Biol. Surv. Mt.

Desert, **6**, Insect Fauna, p. 378 (no specimen); 1946, *Op. cit.*, **7**, Insect Fauna, p. 437 (no specimen).

Olfersia (*Ornithoponus*) *americana* Allen and Gross, 1926, American Game, **15**, p. 82 (on *Bonasa umbellus*).

Lynchia americana Ferris, 1927, Canad. Entom., **59**, p. 248, figs. 2*A–D* and 3 (figures wrongly labelled *L. hirsuta*, but corrected by Ferris, 1929, *Op. cit.*, **61**, p. 285, to *L. americana*. California: Montecito, on *Otus asio bendirei*). Johnson, 1929, Bull. Northeastern Bird-Banding Assoc., **5**, p. 52 (Massachusetts: Boston, on *Buteo l. lineatus;* Middleboro, on *Circus cyaneus hudsonius;* West Tisbury, on *Accipiter striatus velox;* Dover, on *Bubo v. virginianus;* Monterey; Princeton. New Hampshire: Candia, on *Accipiter cooperii*. Pennsylvania: Philadelphia, on *Buteo jamaicensis borealis*. Misspelled *Lynchia america* on p. 51); 1930, Publ. Nantucket M. Mitchell Assoc., **3**, No. 2, p. 158 (no specimen). Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 48 (Indiana, on owl. Oregon, on *Otus asio* [probably subsp. *kennicottii*]). Ferris, 1930, Canad. Entom., **62**, p. 67, figs. 5*A*, *D*, and *F* (California: on owls. West Virginia and Massachusetts: on *Bubo v. virginianus*). J. Bequaert, 1933, Psyche, **40**, p. 72. Peters, 1935, Ann. Carnegie Mus., **24**, p. 57 (Pennsylvania: Hartstown, on *Casmerodius albus egretta*, with Mallophaga, *Ardeicola botauri*, attached); 1936, Bird-Banding, **7**, pp. 11, 13, 14, and 18 (Pennsylvania: on *Accipiter gentilis atricapillus, Buteo l. lineatus, Casmerodius albus egretta,* and *Otus asio naevius*. Ohio: on *Accipiter striatus velox, Buteo jamaicensis borealis* and *Strix v. varia*. South Carolina: on *Accipiter striatus velox, Aquila chrysaëtos canadensis, Circus cyaneus hudsonius, Falco peregrinus anatum, Otus asio naevius* and *Bubo v. virginianus*. North Carolina: on *Buteo jamaicensis borealis*. Maryland: on *Accipiter cooperii* and *Bubo v. virginianus*. Alabama: on *Buteo lineatus alleni*. Georgia: on *Buteo lineatus alleni*. New Hampshire: on *Bonasa u. umbellus* and *Bubo v. virginianus*. New York: on *Bubo v. virginianus*. Illinois: on *Bubo v. virginianus*. Massachusetts: on *Bubo v. virginianus*). Clarke, 1936, Univ. Toronto Stud., Biol. Ser., No. **41**, p. 93 (Ontario: on *Bonasa umbellus togata*). Herman, 1937, Bird-Banding, **8**, p. 164 (Massachusetts: North Eastham, on *Buteo p. platypterus* and *Bubo v. virginianus*). Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 982, footnote. Brimley, 1938, Insects North Carolina, p. 390 (North Carolina: Wilmington; Morehead; Onslow Co.; Roxboro; Anson Co.; Raleigh. On *Accipiter striatus velox, Buteo l. lineatus, Accipiter cooperii*, "hen hawk," *Bubo v. virginianus*, and *Phasianus colchicus*). J. H. Comstock, 1940, Introduction to Entomology, 9th Ed., p. 875. J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416. Snodgrass, 1943, Smithson. Misc. Coll., **104**, No. 1, pp. 44 and 46; figs. 16*A*, *D* and *E*, and 17*A* and *G* (mouth-parts); 1944, *Op. cit.*, **104**, No. 7, pp. 78 and 80; figs. 30*A*, *D* and *E*, and 31*A* and *G* (mouth-parts). J. Bequaert, 1945, Bull. Brooklyn Ent. Soc., **40**, p. 30; 1945, Psyche, **52**, pp. 89 and 100. Edminster, 1947, The Ruffed Grouse, p. 247. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, pp. 411 and 412, fig. 245 (Illinois: Waukegan, on *Asio wilsonianus;* Hyde Ridge, on *Buteo jamaicensis borealis;* Chicago, on *Accipiter cooperii;* Perry, on owl; Urbana; Effingham, on *Bubo v. virginianus;* Shawneetown; Willow Springs, on *Accipiter cooperii*. Iowa: Iowa City, on *Bubo v. virginianus;* McGregor. Michigan: Haslett, Ingham Co., on *Bubo v. virginianus;* Union City, on *Bubo v. virginianus;* East Lansing. Minnesota: Dodge City, on *Bubo v. virginianus;* Minneapolis, on *Strix v. varia;* Olmstead Co.; Hennepin Co.; Shakopee, on *Strix v. varia;* Anthony Park, on *Strix v. varia*. Wisconsin: Pierce Co., on hawk; Maiden Rock, Pierce Co.; W. Spring Green, Sheboygan Co., on

Bubo v. virginianus; Cedar Grove, Sheboygan Co., on *Accipiter cooperii* and *Buteo jamaicensis borealis;* Babcock, Wood Co., on *Bubo v. virginianus;* Portage, Columbia Co., on *Bubo v. virginianus;* Ripon, Fond du Lac Co., on *Bubo virginianus "subarcticus"* [=*B. v. wapacuthu*]; Madison, Dane Co., on *Bubo v. virginianus;* Milwaukee Co., on *Buteo jamaicensis borealis;* Golden Lake, Waukesha Co., on *Bubo v. virginianus*). Herms, 1950, Medical Entomology, 4th Ed., p. 414. Judd, 1951, Canadian Field-Natur., **65,** p. 187 (Ontario: St. Thomas, 42° 48′ N., on *Bubo v. virginianus*).

Lynchia (*Olfersia*) *americana* Champlain, 1947, Pennsylvania Game News, **18,** No. 1, p. 17, fig. (Pennsylvania: on *Bubo v. virginianus,* in some 35 counties).

[*Ornithomyia falconis* Harris, 1833, in Hitchcock, Rept. Geol. Miner. Zool. Bot. Massachusetts, 1st Ed., p. 594 (without description). Osten Sacken, 1858, Cat. Dipt. North America, p. 86. *Nomen nudum*].

Olfersia fusca Macquart, 1845, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1844), p. 346 (no sex; no host. "New Grenada" [=probably Colombia]. Type from Bigot Coll., now in J. E. Collin Coll.) [1846, Dipt. Exot., Suppl. **1,** p. 218]. Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2,** p. 177 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4,** p. 304. Bau, 1929, Zoolog. Anzeiger, **85,** p. 10 (Brazil: without definite locality, supposedly on "*Psittacus undulatus*";[42] also Sete Lagõas, Lagõa Santa, State Minas Gerais, without host).

Lynchia fusca Falcoz, 1930, Encyclop. Entom., Sér. B. Diptera, **5,** (for 1929), p. 47 (Argentina: Misiones. Guiana). J. Bequaert, 1933, Psyche, **40,** p. 76. Herms and Kadner, 1936, Jl. of Parasitology, **22,** p. 541; 1937, *Op. cit.,* **23,** p. 296 (California: on *Bubo virginianus pacificus.* Puparium; experimental transmission of *Haemoproteus lophortyx* to *Lophortyx californica*). J. Bequaert, 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3,** No. 12, p. 416. Laskey, 1941, The Auk, **58,** p. 97 (Tennessee: Nashville, on *Aegolius a. acadicus*). Augustson, 1942, Bull. So. California Ac. Sci., **40,** (for 1941), pt. 3, p. 148 (California: Mono Lake, on *Asio wilsonianus*). J. Bequaert, 1943, Jl. of Parasitology, **29,** p. 132. Herman, 1945, California Fish Game, **31,** pp. 22 and 23, figs. 11*D* and 12 (California: Lassen Co., on *Bubo virginianus pacificus.* Infestation with mites). J. Bequaert, 1945, Psyche, **52,** pp. 89 and 101. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8,** pt. 4, pp. 411 and 417, fig. 246 (Michigan: Hastings, Barry Co., supposedly on squirrel). Herms, 1950, Medical Entomology, 4th Ed., p. 414. Furman and Tarshis, 1953, Jl. of Parasitology, **39,** p. 71 (California: Ripon, San Joaquin Co., on *Bubo virginianus* subsp. Infestation with *Myialges anchora*).

Hippobosca bubonis Packard, 1869 (April), Guide to the Study of Insects, p. 417, fig. 340 (repeated without change in later printings. ♀. On *Bubo v. virginianus,* October 5; no locality. Type ♀ labelled as from Essex Co., Massachusetts, now at Mus. Comp. Zool., Cambridge, Mass.). Brodie and White, 1883, Check List Ins. Dom. Canada, p. 57. Snow and Adams, 1903, Kansas Univ. Sci. Bull., **2,** p. 221 (Kansas: Douglas Co.).

Ornithomyia avicularia Fitch, 1850, Trans. New York State Agric. Soc., **9,** (for 1849), p. 797 (New York: Washington Co., on owl).[43] Not of Linnaeus, 1758.

---

[42] No "*Psittacus undulatus*" is known from Brazil. *Melopsittacus undulatus* (Shaw) is an Australian parrot. Possibly the fly came from a Brazilian zoological garden.

[43] Asa Fitch described his fly as follows: "of a lurid-yellow color, the legs and under side of its body paler, and its wings of a slight

Olfersia macquartii Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 160 (no sex; no host. "New Granada" [= probably Colombia]. With new description of a specimen received from Macquart as *O. fusca*. Type in Natural History Museum in Florence). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 190.

Ornithomyia rufiventris Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 243 (no sex; no host. Brazil: Porto Alegre. Four specimens, one now labelled as type, from Bigot Coll., now in J. E. Collin Coll.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 193 and 195 (copy of description).

Olfersia rufiventris Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 169 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Olfersia nigra Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 181 (Brazil: without precise locality, on owls such as "*Perla flammea*" or suindára [= *Tyto alba tuidara*] and "*Otus clamator*" [= *Rhinoptynx c. clamator*]). Not of Perty, 1833.

[? *Hippobosca aquilae* Brodie and White, 1883, Check List Insects Dominion Canada, p. 57 (no locality, description or host). *Nomen nudum*].

Olfersia sp. J.H. and A.B. Comstock, 1895, Manual Study Insects, p. 488, fig. 595 (wing). J.H. Comstock, 1924, Introduction to Entomology, p. 874, fig. 1118 (wing). Mosby and Handley, 1943, Wild Turkey in Virginia, p. 145 (Virginia: on *Meleagris gallopavo silvestris;* [specimen seen by me]).

Lynchia sp. J.H. Comstock, 1940, Introduction to Entomology, 9th Ed., p. 874, fig. 1118 (wing). Borror and DeLong, 1954, Introduction to Study of Insects, p. 573, fig. 27–13 (sternum).

L. americana has also been reported on grouse, *Bonasa u. umbellus*, in New York State, either as "*Ornithotonus*" *americanus* or as *Lynchia americana*, in the following anonymous Annual Reports of the New York State Conservation Department: 1935, 24th Rept. for 1934, pp. 277 and 278; 1936, 25th Rept. for 1935, p. 325; 1939, 28th Rept. for 1938, p. 246; 1940, 29th Rept. for 1939, p. 236; 1941, 30th Rept. for 1940, p. 221; 1942, 31st Rept. for 1941, p. 216.

Distribution and Specimens Examined. Dominion of Canada. Nova Scotia: Annapolis Royal, Annapolis Co., 44° 45′ N., on *Strix v. varia.* — Ontario (recorded by Walker, 1849; Elliott, 1899; Clarke, 1936; Judd, 1951): without precise locality, on 2 *Bubo v. virginianus* (G.S. Miller, Jr.; R. Thaxter); Chatham, Kent Co., 42° 23′ N., on *Bubo v. virginianus*, Oct. 10 (L.A. Miller), and on *Bubo virginianus wapacuthu*, Jan. 10 (A.A. Wood); Dexter, Thunder Bay Co., 48° 50′ N., on *Bubo v. virginianus*, Oct. 19 (G.M. Stirrett); Athens, Leeds Co., 44° 40′ N., on *Bonasa umbellus togata* (M.W. Curtis); Point Pelée, Essex Co., 41° 54′ N., on *Bubo v. virginianus;* Streetsville, Peel Co., 43° 30′ N., on *Bubo v. virginianus* (McIvor); North Toronto, 43° 39′ N., (S. Thompson); Niagara

---

smoky tinge expanding to the width of eighty-five hundredths of an inch [= about 21 mm.] when spread apart." This agrees with *L. americana*, the size being too large for either *Ornithomyia fringillina* or *Ornithoica vicina*, the only other hippoboscids found on owls in New York State.

Falls, 48° 7′ N., on *Bubo v. virginianus* (R.M. Effrick); Erindale, Peel Co., 43° 35′ N., on *Bubo v. virginianus* (Meadows); within 50 miles of Toronto, on *Bubo v. virginianus* (C. Hope); [Cornwall, Stormont Co., 45° 2′ N., on *Bonasa umbellus togata,* Oct. 13 (C.P. Candee) according to D.M. Davies, *in litt.*; not seen]. — Quebec: Gatineau Point, Hull Co. (near Ottawa), 45° 27′ N., on *Uria l. lomvia* (Hoyes Lloyd); Montreal, on *Bubo v. virginianus,* Feb. 7 (Fr. Adrien Robert); Oka, Deux Montagnes Co., 45° 28′ N., on *Otus asio naevius* (Fr. Lionel Philippe).

United States. Alabama (recorded by Peters, 1936): Randolph Co., on *Zenaidura macroura carolinensis* (A.O. Haugen); Florala, Covington Co., on *Bubo v. virginianus,* Jan. 21; Auburn, Lee Co., on *Otus asio floridanus,* Jan.–Feb.; Fairhope, Baldwin Co., on *Buteo lineatus alleni,* Jan. 16, and *Otus asio floridanus,* Aug. 31 (F.C. Bishopp); Sunflower, Washington Co., Jan. 1 (A.M. Pearson). — Arizona: Hart Prairie, San Francisco Mt., Coconino Co., on *Bubo virginianus pallescens,* Nov. 24 (L.L. Hargrave); Hualpai Mts., Mohave Co., on *Strix occidentalis lucida* (A.R. Phillips). — California (recorded by Ferris and Cole, 1922; Johnson, 1922; Ferris, 1927; Herman, 1945): without precise locality, on *Speotyto cunicularia hypugaea* (W.H. Edwards); Milpitas, Sa. Clara Co., on 3½ weeks old nestling of *Bubo virginianus pacificus,* Apr. 30 (S.K. Carnie); vicinity of San Francisco (F.W. Nunenmacher); Mountain View, Sa. Clara Co., on *Bubo virginianus pacificus,* March (E.W. Ehrhorn); Talmage, Mendocino Co., on *Bubo virginianus pacificus* (J. Adder); Vina, Tehama Co., on 2 *Otus asio bendirei* (S. Freeborn; C.T. Dodds); Butte Co., on *Otus asio bendirei* (Elizabeth Ingles); Colusa, Colusa Co. (A. Wetmore); Sonoma Co., on *Tyto alba pratincola* (C. Rose); Glen Ellen, Sonoma Co. (J.A. Kusche); Healdsburg, Sonoma Co., on *Bubo virginianus pacificus* (W.E. Mack); Yountville, Napa Co., on *Bubo virginianus pacificus,* Aug. 3 (C.M. Herman) and *Otus asio bendirei,* July (T.L. Orlega); Davis, Yolo Co., on large owl; Sacramento, Sacramento Co., on owl, March 19 (F. Hartzell); Manor, Marin Co., on 2 *Strix occidentalis caurina* (E.C. Kinsey; B.B. Kessel); Ripon, San Joaquin Co., Oct. 21, on *Bubo virginianus pacificus* (O. Burnetti); Tracy, San Joaquin Co., from an owl burrow, Feb. 26 (S. Lockwood); Mono Lake, Mono Co., on *Asio wilsonianus,* Aug. 23 (R.I. Rutherford); Menlo Park, San Mateo Co. (J. Hornung); San Mateo, San Mateo Co., on *Bubo virginianus pacificus,* Dec. 30 (R. Henry); Niles Canyon, Alameda Co., on *Tyto alba pratincola* (S. Davidson); Tilden Park, Berkeley, Alameda Co., on *Bubo virginianus pacificus,* June 25 (H.E. Childs,

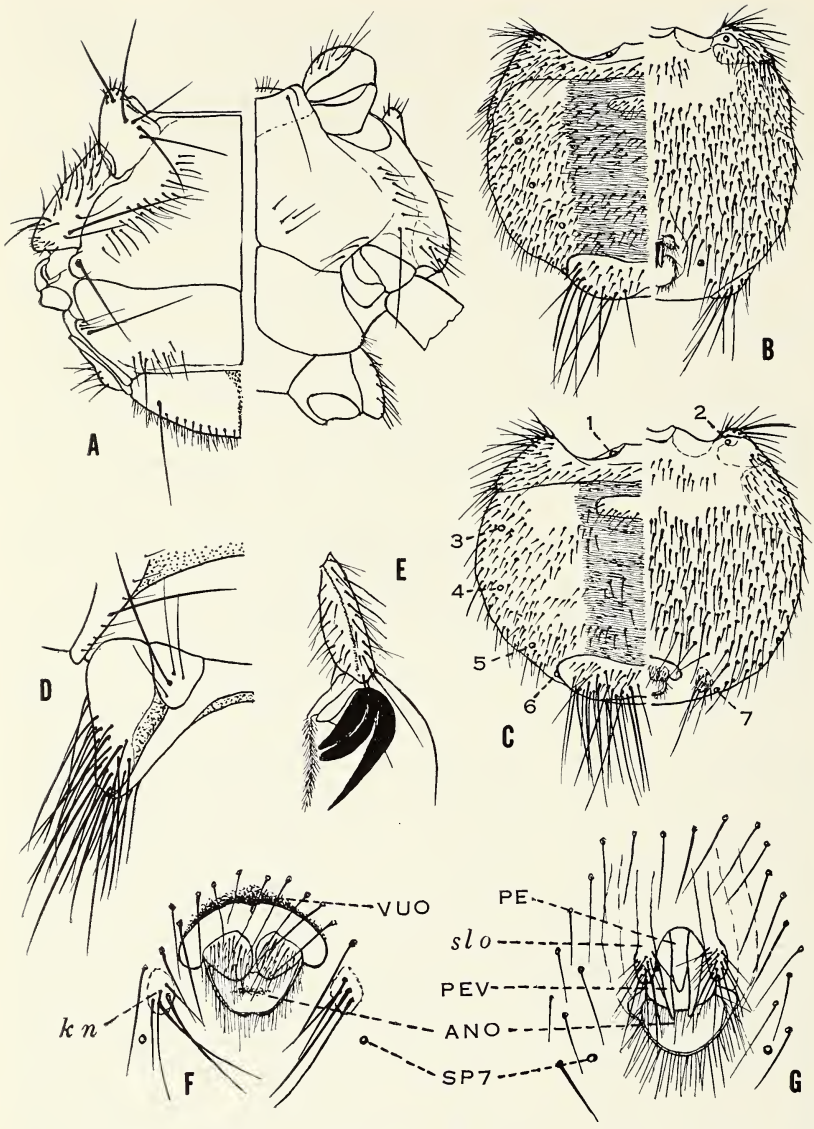

Fig. 52. *Lynchia americana* (Leach); **A**, Hampton, N.H., on *Bubo v. virginianus;* **B** and **G**, Ontario, on *Bubo v. virginianus;* **C** and **F**, Cameron, N.C., on hawk; **D** and **E**, Clarksville, N.Y., on *Bubo v. virginianus:* **A**, thorax dorsally and ventrally, ♀; **B**, abdomen dorsally and ventrally, ♂; **C**, abdomen dorsally and ventrally, ♀, spiracles numbered 1 to 7; **D**, antenna and adjoining frons, ♀; **E**, distitarsus and claw of hind leg, ♀; **F**, tip of abdomen ventrally, ♀:

Jr.); Stanford University, Palo Alto, Sa. Clara Co., on *Otus asio bendirei;* San José, Sa. Clara Co., on *Bubo virginianus pacificus* (Pickwell); Watsonville, Sa. Cruz Co., on owl (Hightower); Hastings Reservation near Jamesburg, Monterey Co., on *Otus asio quercinus,* May 16 (J.M. Linsdale); Huckleberry Meadow, Fresno Co. (R. Hopping); Weldon, Kern Co., on *Bubo virginianus pacificus,* March 2 (K.E. Stager); Santa Barbara, Sa. Barbara Co., on *Tyto alba pratincola* (E. Rett) and on *Bubo virginianus pacificus;* Montecito, Sa. Barbara Co., on *Otus asio bendirei,* June 25 (T.H. Hurst); Mt. Pinos, Ventura Co., on *Bubo virginianus pacificus* (I. Wilson); Santa Paula, Ventura Co., on *Bubo virginianus pallescens* (C.T. Dodds); Monrovia Canyon, Los Angeles Co., on *Bubo virginianus pacificus* (I. Wilson); Pasadena, Los Angeles Co., on *Accipiter striatus velox,* Nov. 29, and *Otus asio quercinus* (Josephine R. Michener); Puente Hills, Los Angeles Co., on *Speotyto cunicularia hypugaea* (E.L. Summers); North Whittier Heights, Los Angeles Co. (Blatz); Chino, San Bernardino Co., on *Tyto alba pratincola,* Sept. 16 (C.M. Herman); San Bernardino Co., on *Bubo virginianus pallescens* and *Tyto alba pratincola* (W.G. Wright); Mission Valley, San Diego Co. (E.W. Clark); Escondido, San Diego Co., on *Otus asio bendirei* (F.N. Gallup); Ceroville, on owl; Watch Creek, on *Bubo virginianus pacificus,* Dec. 1906, and *Tyto alba pratincola* (W. Holden). — Colorado: without precise locality (M. James). — Connecticut (recorded by Britton, 1920; Johnson, 1922): New Haven, New Haven Co., on *Strix v. varia* (R.C. Morrill); Pomfret, Windham Co., on *Bonasa u. umbellus* (P. Wallace); New London, New London Co. (C.B. Groves); Storrs, Tolland Co., on *Bonasa u. umbellus,* Jan. 18, Oct. 18, Oct. 23, Oct. 26, Oct. 27 (on 2 birds), Oct. 28 (on 2 birds), Oct. 31 (on 2 birds), Nov. 1, Nov. 4, Nov. 8, Nov. 11, Nov. 12, Nov. 13, Nov. 15, and Nov. 19, and on *Strix v. varia* (L.R. Penner); Liberty Hill near Willimantic, New London Co., on *Strix n. nebulosa* and *Bonasa u. umbellus* (O. Bangs); Sharon, Litchfield Co., on *Bonasa u. umbellus* (E.A. Deming); Westbrook, Middlesex Co., on *Bubo v. virginianus* (S. Ball); Thomaston, Litchfield Co., on *Bonasa u. umbellus* (R. S. Deck); Woodbridge, New Haven Co., on *Bubo v. virginianus* (J. LeMay); Bridgeport, Fairfield Co., on *Bonasa u. umbellus,* Nov. 5. — Delaware: without precise locality, on *Bubo v. virginianus* (R.M. Stabler). — District of Columbia (recorded by Ferris and Cole, 1922): on *Bubo v. virgini-*

ANO, anal opening; *kn,* setigerous knob; *SP7,* 7th abdominal spiracle; *VUO,* vulvar opening; **G**, tip of abdomen ventrally, ♂: *PE,* penis; *PEV,* penis valves; *SP7,* 7th abdominal spiracle; *slo,* setigerous lobe at side of genital atrium.

anus (Mrs. R.C. Simpson) and *Buteo jamaicensis borealis,* Dec. 1 (B. Horsfall); Zoological Park, on *Accipiter striatus velox,* March 16, on *Strix v. varia,* Jan. 27, and on the Mexican bird *Calocitta f. formosa,* March 21. — Florida (recorded by Johnson, 1895, 1913): Lemon City, Dade Co. (E.J. Brown); Gainesville, Alachua Co., on *Haliaeëtus l. leucocephalus* (T.H. Hubbell); Sanford, Seminole Co., (F.M. Uhler); Elfers, Pasco Co., May 13 (W.G. Fargo); White City, St. Lucie Co. (C.J. Nielson); Eau Gallie, Brevard Co., on *Otus asio floridanus,* May 9, and *Strix varia georgica,* March 17 (W.W. Worthington); Gainesville, Alachua Co., on *Strix varia georgica,* Dec. 27 (T.H. Hubbell); Miami, Dade Co., on *Bubo v. virginianus,* March 28 (P. Laurent); Paradise Key, Dade Co., on *Strix varia georgica,* Feb. (W.S. Brooks); St. Augustine, St. Johns Co., on *Otus asio floridanus* (C.W. Johnson); Brooksville, Hernando Co., on young *Otus asio floridanus,* June 26 (L. von Borowsky); Bradenton, Manatee Co., on *Otus asio floridanus,* Jan. 20 (A. Wetmore); Merritt's I., Brevard Co., on *Bubo v. virginianus,* Dec. 29 (D.J. Nicholson); Saint Cloud, Osceola Co., on owl, May 30 (F.C. Bishopp). — Georgia (recorded by Leach, 1817; Peters, 1936): Brunswick, Glynn Co., on *Strix varia georgica,* March 9 (A.V.J. Clark); Thomasville, Thomas Co., on *Otus a. asio,* Oct. 20 (B.V. Travis); Atlanta, on *Bubo v. virginianus,* Sept. 25 (C. Wharton); Lumber City, Telfair Co., on *Bubo v. virginianus* (C.A. Locke); Beachton, Grady Co., on *Strix varia georgica,* Aug. 2 (E.V. Komarek); Cumberland I., Camden Co., on owl (O.G. Ricketson, Jr.); Oatland I., Chatham Co., on *Buteo jamaicensis borealis* (R.H. McCauley, Jr.); Experiment, Spalding Co., Dec. 6, on hawk (C.M. Beckham); [Cartersville, Bartow Co., on *Accipiter cooperii;* Dalton, Whitfield Co., on *Otus a. asio;* Griffin, Spalding Co., on *Otus a. asio.* — According to P.W. Fattig, *in litt.;* not seen]. — Illinois (recorded by Osten Sacken, 1878; Johnson, 1922; Peters, 1936; MacArthur, 1948): Pike Co., on *Bubo v. virginianus,* July 30 (L.J. Hayden); Waukegan, Lake Co., on *Asio wilsonianus* (W.I. Lyon); Kansas, Edgar Co., on *Accipiter cooperii,* Sept. 14 (W.B. Taber, Jr.); Perry, Pike Co., on owl (C.W. Brown); 2 miles W. of Carterville, Williamson Co., on *Strix v. varia,* Dec. 17 (P.W. Parmalee); Urbana, Champaign Co. (M. James) and on *Bubo v. virginianus* (F. Laznicka); Pana, Christian Co., on *Buteo jamaicensis borealis,* Sept. 1 (P.W. Parmalee); Willow Springs, Cook Co., on *Accipiter cooperii* (F. Laznicka); Hyde Ridge, on *Buteo jamaicensis borealis* (H.L. Stoddard). — Indiana (recorded by Falcoz, 1930): Indianapolis, on owl; Bedford, Lawrence Co., on *Colinus v. virginianus* (J.J. Davis);

Bluffton, Wells Co., on 2 *Bubo v. virginianus,* Oct. 30, Dec. 22 (E.B. Williamson). — Iowa (recorded by MacArthur, 1948) : Ames, Story Co.; McGregor, Clayton Co. (T. Pope) ; Iowa City (H.F. Wickham; L. Buchanan), on *Otus asio naevius,* Dec. 1, and *Bonasa u. umbellus,* Nov. 9 (H.R. Dill), on *Corvus b. brachyrhynchos,* Nov. 24 (A. Bailey), and on *Bubo v. virginianus* (H.W. Lindsey) ; Keokuk, Lee Co., on *Otus asio naevius* (J.M. Scheller). — Kansas (recorded by Snow and Adams, 1903) : Franklin Co. (W. Clanton) and on *Buteo jamaicensis borealis* (H.K. Gloyd) ; Meade Co. (C.W. Hibbard) ; Douglas Co., on *Bubo v. virginianus* (F.H. Snow) ; Clay Co. (L.D. Anderson) ; Riley Co. (E.A. Popenoe). — Kentucky (recorded by Swenk, 1916) : Louisville, Jefferson Co. — Louisiana : Alexandria, Rapides Parish, Sept. 14 (C.R. Jones and R.A. Cushman) ; Kilbourne, West Carroll Parish, on *Strix varia georgica,* Nov. 8 (W.W. Wirth) ; Ruston, Lincoln Parish, on Man (W.W. Wirth) ; Crowville, Franklin Parish, on *Strix varia georgica,* Nov. 3 (G. Lowrey) ; Natchitoches, Natchitoches Parish, on owl, Nov. 28 (E. Herrick) ; Camp Salmen, Slidell, Saint Tammany Parish, on *Otus asio floridanus,* Oct. 28 (T. Hall, Jr.). — Maine (recorded by Johnson, 1925; Procter, 1938, 1946) : without precise locality, on *Bonasa umbellus togata;* Portland, Cumberland Co., on *Buteo jamaicensis borealis* (A.G. Johnson) ; Kittery Point, York Co., on *Accipiter cooperii* (R. Thaxter) ; Dryden, Franklin Co., on *Colinus v. virginianus,* Oct. 21 (G.H. Heinrich) ; Oxford Co., on *Dryocopus pileatus abieticola* (F.A. Hartman). — Maryland (recorded by Peters, 1936) : Accokeet, Prince Georges Co., on *Bubo v. virginianus,* Oct. 13 (W.H. Coleman) ; Plummers I., Montgomery Co., on *Accipiter cooperii,* March 16 (E.A. Chapin) ; Sandy Spring, Montgomery Co., on *Strix v. varia* (A.K. Fisher) ; Beltsville, Prince Georges Co., on *Buteo jamaicensis borealis* (R.T. Mitchell) ; Baltimore, on *Accipiter cooperii* (J. Thompson) ; Laurel, Prince Georges Co., on *Buteo l. lineatus,* July 5, and *Accipiter striatus velox,* Feb. 19 (E.B. Marshall), and on *Bubo v. virginianus,* Dec. 29 (F.C. Bishopp) ; Patuxent Refuge, Bowie, Prince Georges Co., on *Buteo jamaicensis borealis, Bubo v. virginianus,* March 15; *Strix v. varia,* and *Accipiter cooperii,* Oct. 26 (R.T. Mitchell) ; Rockville, Montgomery Co., on *Bubo v. virginianus,* July 21, and *Colinus v. virginianus,* Dec. 27 (C.R. Aschemeyer) ; Elliott I., on *Corvus ossifragus* (R.E. Stewart) ; Morgantown, Charles Co., on *Strix v. varia,* Sept. 12 (E.B. Marshall) ; Port Republic, Calvert Co., on *Bubo v. virginianus,* June 20 (G.F. Gravatt) ; Gaithersburg, Montgomery Co., on *Bubo v. virginianus,* Feb. 15 (Alva Nye) ; Bethesda, Montgomery Co., on hawk

(W.H.W. Komp); Burtonsville, Montgomery Co., on *Accipiter cooperii* (E.B. Marshall); Blackwater Refuge, Dorchester Co., on *Buteo jamaicensis borealis*, Nov. 9. — MASSACHUSETTS (recorded by Harris, 1835; Packard, 1869; Johnson, 1922, 1925, 1929; Peters, 1936; Herman, 1937): Princeton, Worcester Co., on *Bonasa u. umbellus* (J.D. Smith); Ware, Hampshire Co., on *Phasianus colchicus* (S. Pilch); Dover, Norfolk Co., on *Bubo v. virginianus* (A.P. Morse); Wellfleet, Barnstable Co., on *Bubo v. virginianus* (R.P. Dow); Wenham, Essex Co., on 2 *Bubo v. virginianus*, Sept. 28 and Dec. 2 (J.C. Phillips); West Springfield, Hampden Co., on *Bonasa u. umbellus;* Ayer, Middlesex Co., on *Accipiter gentilis atricapillus* (J. Peters); Monterey, Berkshire Co., on *Bonasa u. umbellus;* Amherst, Hampshire Co., on *Bonasa u. umbellus* and *Phasianus colchicus* (C.P. Alexander); Paxton, Worcester Co., on *Bonasa u. umbellus* (C.H. Sparrell); Greenfield, Franklin Co., on *Bonasa u. umbellus* and *Bubo v. virginianus* (C.P. Alexander); Wayland, Middlesex Co., on *Bubo v. virginianus* (S. Helleigh); South Hadley, Hampshire Co., on *Bubo v. virginianus* (Elizabeth M. Boyd); Chilmark, Dukes Co., on *Buteo jamaicensis borealis* (G.D. Eustis); Lenox, Berkshire Co., on *Bubo v. virginianus*, Aug. (F.C. Bishopp); Gloucester, Essex Co., on *Haliaeëtus l. leucocephalus,* Nov. 4 (E. Birdseye); North Eastham, Barnstable Co., on *Bubo v. virginianus* (C.M. Herman); Harvard, Worcester Co., on *Bubo v. virginianus* and *Strix v. varia* (J. Peters); Boston, on *Buteo l. lineatus,* Aug. 13; Middleboro, Plymouth Co., on *Circus cyaneus hudsonius* (E.H. Forbush); Martha's Vineyard, on *Accipiter cooperii* and *Buteo jamaicensis borealis* (Cleveland); Cohasset, Norfolk Co., on *Strix v. varia*, Nov. 28 (J.S. Brown); West Tisbury, Dukes Co., on *Accipiter striatus velox,* May 31 (A. Keniston); Framingham, Middlesex Co., on *Strix v. varia*, Nov. 1; Sherborn, Middlesex Co., on *Buteo l. lineatus* (A.P. Morse); Petersham, Worcester Co., trapped on fly paper, July, 1946 (C.T. Brues); Chicopee, Hampden Co.; Fall River, Bristol Co. — MICHIGAN (recorded by MacArthur, 1948): Vicksburg, Kalamazoo Co., on *Bubo v. virginianus* (F.W. Rapp); Ann Arbor, Washtenaw Co., on *Bubo v. virginianus,* Nov. 13 (C.C. Adams); Haslett, Ingham Co., on *Bubo v. virginianus* (F. Palmerlee); Union City, Branch Co., on *Bubo v. virginianus* (C.W. Hill); Grosse Isle, Wayne Co., Aug. 27; Jackson, Jackson Co., on *Bubo v. virginianus* (W.C. Fargo); Hastings, Barry Co., supposedly on a squirrel (W.C. Laubaugh); Base Lake, Washtenaw Co., on *Strix v. varia* (W.L. Conkle); Augusta, Kalamazoo Co., on *Bubo v. virginianus;* Ypsilanti, Washtenaw Co., on *Strix v. varia;* Cascade Glen, Ann Arbor,

Washtenaw Co. (T.H. Hubbell); Laingsburg, Shiawassee Co., on *Buteo l. lineatus* (Sherizer); Independence Lake, Washtenaw Co., on *Bubo v. virginianus;* E. S. George Reserve, Livingston Co., on *Accipiter cooperii;* Lima, Washtenaw Co., on owl (W. Blair). — Minnesota (recorded by Washburn, 1905; Green and Shillinger, 1935; MacArthur, 1948): Elk River, Sherburne Co., 45° 20′ N., on *Accipiter cooperii,* Aug. 8 (B. Bailey); Dodge Co., 44° N., on *Bubo v. virginianus,* May 10 (G. Swanson); Shakopee, Scott Co., 49° 20′ N., on *Strix v. varia* (G. Swanson); St. Anthony Park, near Minneapolis, on *Strix v. varia;* Minneapolis, on *Strix v. varia;* Olmsted Co., 44° N.; Hennepin Co., 45° N. (O.W. Oestlund). — Mississippi: Old River Lake, on 2 *Buteo p. platypterus,* Aug. 24 and Nov. 20 (M.G. Vaiden); Picayune, Pearl River Co., on wild *Meleagris gallopavo silvestris,* Feb., 1926 (J.A. McLemore; through A. Stone); Rosedale, Bolivar Co., on *Accipiter cooperii* (M.G. Vaiden); Laurel, Jones Co., on *Otus a. asio* (G.L. Bond); Oxford, Lafayette Co., on *Buteo jamaicensis borealis* (F.M. Hull); Kossuth, Alcorn Co., on *Bubo v. virginianus;* Agricultural College, Oktibbeha Co., on *Strix varia georgica;* Waynesboro, Wayne Co., on hawk. — Missouri: St. Louis, on hawk, probably *Buteo jamaicensis borealis* (C.C. Magrath); Fulton, Callaway Co., on *Colinus v. virginianus* (G.W. Thomas). — Nebraska (recorded by Swenk, 1916): Westpoint, Cuming Co., on *Buteo lagopus sancti-johannis* (L. Bruner); Brownville, Nemaha Co., on *Bubo v. virginianus.* — Nevada: without precise locality (Ac.Nat.Sci.Phila.). — New Hampshire (recorded by Johnson, 1922, 1929; Peters, 1936): Durham, Strafford Co., on *Strix v. varia* (J.G. Conklin); Sandwich, Carroll Co., on *Buteo p. platypterus* (R.G. Carpenter); Washington, Sullivan Co., on *Bonasa u. umbellus* (R.G. Carpenter); Keene, Cheshire Co., on *Bonasa u. umbellus,* March 30 (L.R. Nelson); East Westmoreland, Cheshire Co., on *Bonasa u. umbellus* (L.O. Shelley); Newmarket, Rockingham Co., on *Bonasa u. umbellus* (J. Moffit); Hampton, Rockingham Co., on hawk, *Bubo v. virginianus* and *Asio wilsonianus,* Apr. 9 (S.A. Shaw); Candia, Rockingham Co., on *Accipiter cooperii* (C.L. Hathaway); Windsor, Windsor Co., Nov. 6, on *Bonasa u. umbellus* (H.R. Siegler). — New Jersey (recorded by Johnson, 1900, 1910): Andover, Sussex Co., on *Accipiter striatus velox,* Oct. 4; Ramsey, Bergen Co. (C.E. Sleight); Chester, Morris Co., on *Asio wilsonianus* (J. Assmuth); North Hackensack, Bergen Co., on *Accipiter gentilis atricapillus* (W.DeW. Miller); Medford, Burlington Co.; Stone Harbor, Cape May Co.; Stag Lake, Sussex Co., on *Buteo jamaicensis borealis,* Oct. 10 (W.L. McAtee; W. DeW. Miller); Milton, Morris

Co., on *Strix v. varia;* Boonton, Morris Co., on *Bubo v. virginianus* (T.D. Carter); Haddonfield, Camden Co., on *Bubo v. virginianus* and *Buteo jamaicensis borealis* (C.W. Johnson); Kittatinny Mts., Sussex Co., on *Aquila chrysaëtos canadensis* and *Otus asio naevius* (C.W. Johnson).—New York (recorded by Davis, 1922; Johannsen, 1928; Peters, 1936): near New York City, on 2 *Bubo v. virginianus* (E.E. Wehr; D.L. Coffin); Staten Island, Nov. 24 (W.T. Davis); Long Island, on *Buteo jamaicensis borealis;* Orient Point, Long Island, on *Buteo jamaicensis borealis,* Dec. 16 (F.M. Schott); Coeymans, Albany Co., on *Bubo v. virginianus;* Freeport, Long Island, on *Circus cyaneus hudsonius,* Sept. 13 (H. Thurston); White Plains, Westchester Co., on *Zonotrichia albicollis* (Calvin Farley); Hechscher State Park near Islip, Suffolk Co., on *Falco c. columbarius,* Apr. 8 (R.V. Nardy); Yankee Lake, Wurtsboro, Sullivan Co., on *Buteo p. platypterus,* Sept. 6 (J.P. Chapin); Taganie, Ithaca, Tompkins Co., on *Bubo v. virginianus,* Nov. 1 (L.A. Fuertes); Robbin's I., Peconic Bay, Suffolk Co., on 3 of 6 *Phasianus colchicus* examined (L.R. Penner); Austerlitz, Columbia Co., on *Bonasa u. umbellus,* Oct. 23 (H. Thurston); West Point, Orange Co., on *Bonasa u. umbellus,* Nov. 3, and *Accipiter gentilis atricapillus,* Oct. 26 (W. Robinson); Clarksville, Albany Co., on *Bubo v. virginianus,* Oct. 5 (R. Matheson); Altamont, Albany Co., on *Bonasa u. umbellus* and 95 specimens on one *Bubo v. virginianus* (A. Paladin); East Greenbush, Rensselaer Co., on *Strix v. varia;* Honeoye Lake, Ontario Co., on *Haliaeëtus l. leucocephalus,* Sept. 17 (R.L. Post); Chatham, Columbia Co.; Rushford, Allegany Co., on *Bonasa u. umbellus* (L.L. Pechuman); Baldwinsville, Onondaga Co., on *Bubo v. virginianus,* Dec. 21 (A.G. Whitney); North Lansing, Tompkins Co., on *Bubo v. virginianus* (W. Middlekauff); Morton, Orleans Co., on *Bubo v. virginianus,* Jan. (F.C. Bishopp); Ellis Hollow near Ithaca, Tompkins Co., on *Bubo v. virginianus,* Aug. 28 (C.E. Palm); Ithaca, Tompkins Co., on *Accipiter cooperii,* Oct. 31 (W.J. Hamilton), on *Bubo v. virginianus,* Oct. 26, 2 *Bonasa u. umbellus,* Nov. 15 and Oct. 1, and *Phasianus colchicus,* Oct. 17 (H.H. Schwardt), and on *Buteo l. lineatus,* Sept. 16 (M.D. Pirnie); Waterburg, S. of Trumansburg, Tompkins Co., on *Bubo v. virginianus,* Nov. 3 (G.W.P. Lassmann); Utica, Oneida Co., on *Colinus v. virginianus,* Nov. 3; Marathon, Cortland Co., on *Bubo v. virginianus,* Sept. 21, *Phasianus colchicus,* and *Buteo l. lineatus,* July 14 (F.C. Goble); Buffalo, on *Bubo v. virginianus* (W. Wild); Orient, Long Island, on *Bubo v. virginianus,* Jan. 1, and *Accipiter striatus velox,* Dec. 7 (R. Latham); Albany, on *Strix v. varia* and *Bubo v. virginianus,* Oct. 24 (D. Stoner); Wells-

ville, Allegany Co., on *Bonasa u. umbellus,* Nov. 6 (Wilson); Noyack, Long Island, on *Bubo v. virginianus,* Jan. 20 (W.M. Evarett); Kotonah, Westchester Co., on *Corvus b. brachyrhynchos;* Stamford, Delaware Co., on *Bonasa u. umbellus,* Oct. 26 (E. Finegan); Rensselaerville, Albany Co., on *Accipiter cooperii* (E.J. Gerberg); McLean Bogs near Ithaca, Tompkins Co., on *Asio wilsonianus,* Nov. 27; Carmel, Putnam Co.; Sparta, Livingston Co., on *Bonasa u. umbellus,* Dec. (R. Matheson). [According to E.K. LeDune, *in litt., L. americana* was taken in 1934–1936 on *Bonasa u. umbellus* in the following counties: Chemung, Westchester, Albany, Allegany, Chenango, Delaware, Essex, Jefferson, Lewis, and Tompkins]. — North Carolina (recorded by Peters, 1936; Brimley, 1938): Raleigh, Wake Co., on 2 *Bubo v. virginianus* (C.S. Brimley; Z.P. Metcalf), on *Otus a. asio* (Mrs. R.C. Simpson), on 2 *Strix v. varia,* Dec. 4 (C.S. Brimley; Mrs. R.C. Simpson), on *Buteo jamaicensis borealis* (Mrs. R.C. Simpson), on 2 *Buteo l. lineatus* (Mrs. R.C. Simpson; R. Collie), on *Buteo p. platypterus* (Mrs. R.C. Simpson), and on *Accipiter striatus velox* and *Accipiter cooperii* (C.S. Brimley); Craggy Mt., Buncombe Co., on hawk (H.B. Teague); Pisgah National Forest, in western section, on *Buteo jamaicensis borealis,* Dec. 5 (F.C. Bishopp); Morehead City, Carteret Co., on "hen hawk" (Miss G. Oaksmith); Burlington, Alamance Co., on "chicken hawk"; Johnston Co., on *Pandion haliaetus carolinensis* (Mrs. R.C. Simpson); Wake Co., on *Accipiter cooperii* (J. Dermid); Wilmington, New Hanover Co., on *Strix v. varia,* Nov. 22 (M. Kisliuk); Brunswick Co., on *Buteo jamaicensis borealis* (Mrs. R.C. Simpson); Mt. Olive, Wayne Co., on *Buteo l. lineatus* (Mrs. R.C. Simpson); Onslow Co., on *Strix v. varia* (H.T. Davis); Roxboro, Person Co., on *Bubo v. virginianus* (Mrs. R.C. Simpson); McFarlan, Anson Co., on *Bubo v. virginianus* (Mrs. R.C. Simpson); Worthville, Randolph Co., on *Colinus v. virginianus,* Jan. 3 (P.V. Carpenter); Cameron, Moore Co., on *Buteo jamaicensis borealis,* July 11 (W.F. Douglas); Hoffman, Richmond Co., on *Bubo v. virginianus* (Mrs. R.C. Simpson); Big Cave, Cherokee Reservation, Swain Co., on *Buteo jamaicensis borealis* (A. Stupka); Alamance Co., on *Bubo v. virginianus* (A. Breckenridge); Fuquay, Wake Co., on *Buteo jamaicensis borealis* (F.B. Meachan); Nantahala National Forest, Macon Co., June 23 (W.H. Ball); Durham, Durham Co., on *Buteo jamaicensis borealis,* Nov. 13 (R.E. Lee), and on wild *Meleagris gallopavo silvestris,* Dec. 15, 1944 (D.W. Carter; through A. Stone); Roxobel, Bertie Co., on "hoot owl"; Greensboro, Guilford Co., on domestic chicken. — North Dakota: Devils Lake, Ramsey Co., 48° 10′ N., on 2 *Buteo jamaicensis calurus* (T.H.

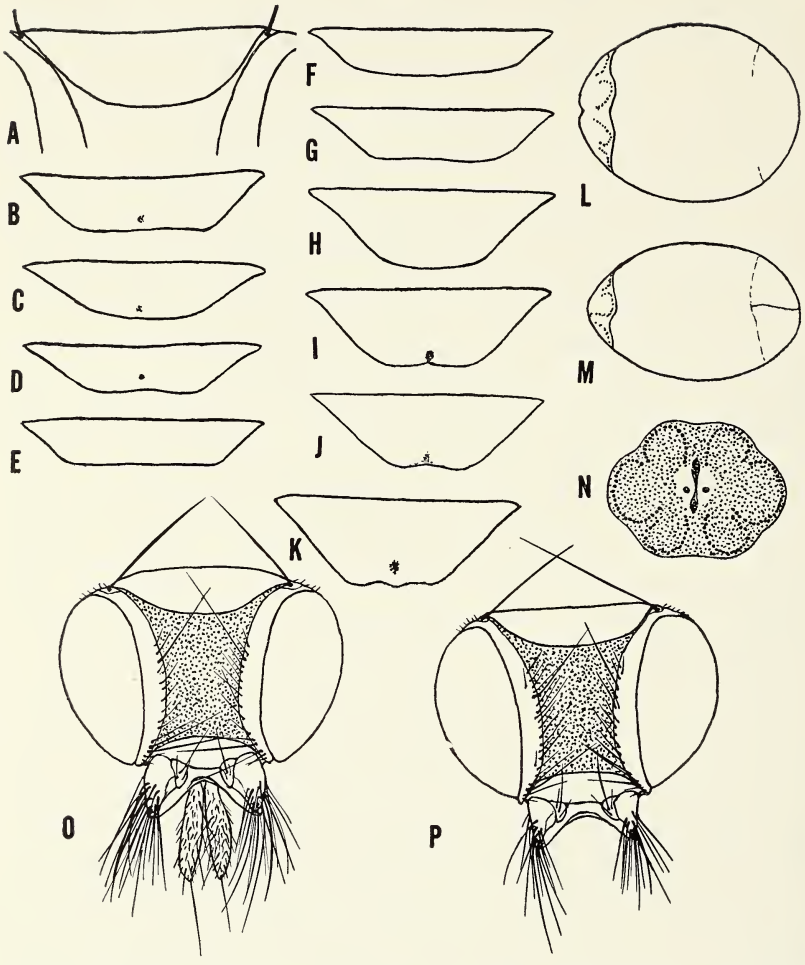

Fig. 53. *Lynchia americana* (Leach). **A–K,** outline of postvertex: **A,** Leach's ♀, holotype; **B,** ♀, Kittatinny Mts., N.J., on *Aquila chrysaëtos canadensis;* **C,** ♀, Wisconsin, on *Bonasa u. umbellus;* **D,** ♀, on *Meleagris gallopavo silvestris;* **E,** ♀, Raleigh, N.C., on *Bubo v. virginianus;* **F–H,** 3 ♀, Ellis Hollow, N.Y., on *Bubo v. virginianus;* **I,** ♀, California; **J,** ♀, Tigard, Ore., on *Otus asio brewsteri;* **K,** ♂, Sa. Cruz de la Sierra, Bolivia, on *Glaucidium b. brasilianum;* **L–N,** puparium, Ontario, from above (**L**), and in side view (**M**) and respiratory lobes (**N**); **O,** head, ♀, Clarksville, N.Y., on *Bubo v. virginianus;* **P,** head, ♂, Ontario, on *Bubo v. virginianus.*

Hubbell). — Ohio (recorded by Peters, 1936) : without precise locality, on *Bubo v. virginianus,* Dec. 2; Franklin Co., on *Accipiter cooperii* (J. Dusi) ; Senecaville, Guernsey Co.; Paulding Co., on *Tyto alba pratincola* (O.E. Ehrhard) ; Cuyahoga Co., on hawk (T.H. Parks) ; Cleveland, on *Strix v. varia,* Aug. 22 (F.C. Bishopp) ; Greenville, Darke Co., on *Bubo v. virginianus* (R. Rausch) ; Columbus, Franklin Co., on *Strix v. varia* and *Accipiter cooperii* (R.M. Goslin) ; Leetonia, Columbiana Co., on *Accipiter striatus velox* (F.C. Bishopp) ; Hammondsville, Jefferson Co., on *Bubo v. virginianus* (J.S. Barnes) ; Marietta, Washington Co., on *Buteo jamaicensis borealis* (G. Link) ; Youngstown, Mahoning Co., on *Buteo jamaicensis borealis* (G. Link) ; Glouster, Athens Co., on *Accipiter cooperii,* Nov. 26 (B.G. Swartz) ; Mohican State Park, Loudonville, Ashland Co., on *Buteo jamaicensis borealis* (F.J. Ligas) ; Morrow Co., on *Accipiter cooperii* (E.S. Thomas) ; Buckeye Lake, Fairfield Co., on a nestling *Accipiter cooperii,* June 25 (R. Franks), on *Buteo jamaicensis borealis* (C.F. Walker), and on *Strix v. varia* (R.M. Goslin) ; Licking Co., on *Bubo v. virginianus,* Oct. 15 (F.H. Smith) ; Crestline, Crawford Co.; Wauseon, Fulton Co.; Mt. Gilead, Morrow Co., on *Buteo jamaicensis borealis* (G. Thompson) ; Wilmington, Clinton Co., on *Accipiter cooperii* (C.F. Walker) ; Grafton, Lorain Co., on *Bubo v. virginianus;* Danville, Knox Co., on *Accipiter striatus velox;* Galion, Crawford Co., on *Bubo v. virginianus* (E.S. Thomas and C.F. Walker) ; McConnelsville, Morgan Co., on *Bubo v. virginianus* (C.F. Walker) ; Hillsboro, Highland Co., on *Bubo v. virginianus* (E.S. Thomas, R. Goslin and A. Stupka) ; Tar Hollow, Ross Co., (G.S. Crowl) ; Freedom, Portage Co., on *Accipiter cooperii,* Nov. 4 (F.C. Bishopp) ; Marysville, Union Co., on *Bubo v. virginianus* (R. Rausch). — Oregon (recorded by Cole and Lovett, 1921; Falcoz, 1930) : Corvallis, Benton Co., on *Otus asio kennicottii* (I.N. Gabrielson), and 2 *Bubo virginianus saturatus* (J.W. Jarvis; W.J. Chamberlin) ; Lebanon, Linn Co., on *Bubo virginianus pacificus,* Nov. (W.J. Chamberlin) ; Shedd, Linn Co., (W.J. Chamberlin) ; Illahe, Curry Co., on *Otus asio brewsteri* (L. Miller) ; Maupin, Wasco Co., on *Otus asio macfarlanei* (S. G. Jewett) ; Salem, Marion Co. (J. Harrington) ; Roseburg, Douglas Co. (G.B. Thompson) ; Adel, Lake Co., on *Bubo virginianus pacificus,* May 19 (A. Walker) ; Gold Hill, Jackson Co. (C.R. Biederman) ; Tigard, Washington Co., on *Otus asio brewsteri* (J.E. Davis). — Pennsylvania (recorded by Johnson, 1929; Peters, 1933, 1936; Champlain, 1947) : without precise locality, on *Accipiter gentilis atricapillus* (R. Fricke), and on *Buteo jamaicensis borealis* and *Bubo v. virginianus* (M. Wood) ; Wilkin-

son, Lawrence Co., on *Otus asio naevius* (H.D. Kirk); Reading, Berks Co., on *Otus asio naevius,* Dec. 3 (T.E. Winecoff), and on *Accipiter cooperii* and *Phasianus colchicus* (L.S. Dillon); Elk Co., on *Accipiter gentilis atricapillus,* Apr. 16 (F.C. Bishopp); State College, Centre Co. (L.S. Dillon); Lackawanna Co., on *Accipiter gentilis atricapillus* (Wilson); Delaware Co., on *Buteo jamaicensis borealis;* Chester, Delaware Co., on *Buteo p. platypterus;* Meckville, Berks Co., on *Buteo jamaicensis borealis* (L.S. Dillon); Stony Creek, Berks Co. (L.S. Dillon); Hawk Mountain, Berks Co., on *Buteo p. platypterus* (L.S. Dillon); Bernville, Berks Co., on *Circus cyaneus hudsonius* (L.S. Dillon); Newton, Mifflin Co., on *Buteo jamaicensis borealis* (L.S. Dillon); Berks Co., on *Buteo p. platypterus* (L.S. Dillon); Fisherville, Dauphin Co., on *Asio wilsonianus* (L.S. Dillon); Exeter Township, Berks Co., on *Accipiter gentilis atricapillus* (L.S. Dillon); Frick Park, Pittsburgh, on *Accipiter cooperii* (W.L. Black); Clinton Co., on *Bubo v. virginianus* (G. Link); Butler, Butler Co., on *Bubo v. virginianus* (G. Link); Washington Co., on *Aquila chrysaëtos canadensis*; Titusville, Crawford Co., on *Bonasa u. umbellus* (H. Roslund); Hartstown, Crawford Co., on *Casmerodius albus egretta,* with Mallophaga attached (W.E.C. Todd) and on *Asio wilsonianus* (G. Netting); Allegheny Co., on *Phasianus colchicus* (A. Miller) and *Colinus v. virginianus* (G. Link); Bellowsville near Vanport, Beaver Co., on *Buteo jamaicensis borealis* (W.E.C. Todd); New Kensington, West Moreland Co., on *Accipiter cooperii* (R. Fricke); Wallingford, Delaware Co. (R.M. Stabler); Mt. Lebanon, Allegheny Co., on *Bubo v. virginianus* (J. Guilday); Frankford, Philadelphia Co., on owl (L.O. Davis); Sherrett, Armstrong Co., on *Buteo jamaicensis borealis;* Pittsburgh, an *Asio wilsonianus;* Pike Co. (P. Laurent); Pocona Lake, Monroe Co., on *Accipiter gentilis atricapillus;* Spruce Creek, Centre Co., on *Bubo v. virginianus;* Waynesburg, Greene Co., on *Bubo v. virginianus;* Scranton, Lackawanna Co. on *Phasianus colchicus* and *Bubo v. virginianus* (Everhart); Cumberland Co., on *Strix v. varia* (J.N. Knull); Dauphin Co. (T.E. Winecoff), and on *Buteo jamaicensis borealis* (C.W. Johnson); Philadelphia, on *Buteo jamaicensis borealis* (C.W. Johnson); Eshcol, Perry Co.; Penfield, Clearfield Co.; Shirleysburg, Huntingdon Co.; Harrisburg, Dauphin Co. — Rhode Island: Wakefield, Washington Co., on *Asio wilsonianus* (E.L. Coman); Kingston, Washington Co. (H. Knutson). — South Carolina (recorded by Howard, 1883; Johnson, 1925; Peters, 1936): Sheldon, Beaufort Co., on owl; Greenwood, Greenwood Co., on *Otus a. asio,* Nov. 28 (J.G. Watts); Santee Club, Charles-

ton Co., on wild *Meleagris gallopavo silvestris* (W.L. McAtee); Cordesville, Berkeley Co., on *Aquila chrysaëtos canadensis,* Feb. 25 (F.C. Bishopp); Clemson College, Oconee Co., on *Bubo v. virginianus,* Dec. 2, and *Buteo l. lineatus* (D. Dunavan); Society Hill, Darlington Co., on *Bubo v. virginianus;* Charleston, Charleston Co., on *Bubo v. virginianus,* March 30 (J. Akhurst), and on *Accipiter striatus velox, Circus cyaneus hudsonius,* Jan. 11, and *Falco peregrinus anatum,* Nov. 7 (F.C. Bishopp); Summerville, Dorchester Co., on 2 *Otus a. asio,* Feb. 7 and Sept. 26 (W.P. Wharton); Port Royal, Beaufort Co. (E.S. Prevost); Pomaria, Newberry Co., on *Bubo v. virginianus* (F. Sherman); Dewees I., Charleston Co., on *Bubo v. virginianus* (E.K. Moore). — Tennessee (recorded by Laskey, 1941): without precise locality, on *Colinus v. virginianus* (R.S. Walker); Elkmont, Sevier Co., on *Bubo v. virginianus* (A. Stupka); Knoxville, Knox Co. (A.C. Cole); White House, Robertson Co., on *Bubo v. virginianus* (Mrs. A.R. Laskey); Dudley Creek, Great Smoky Mts. Nat. Pk., on *Bubo v. virginianus* (A. Stupka); Nashville, Davidson Co., on *Accipiter cooperii,* Aug. 26, *Aegolius a. acadicus, Corvus b. brachyrhynchos, Buteo jamaicensis borealis,* and *Otus asio naevius* (Mrs. A.R. Laskey); Clarksville, Montgomery Co., Oct. 18, on hawk; Scotts Hill, Henderson Co., on owl, Oct. (Mrs. N.L. Goff); Craggie Hope, Cheatham Co., on *Bubo v. virginianus* (Mrs. A.R. Laskey). — Texas (recorded by Osten Sacken, 1878; Johnson, 1922): without precise locality, on *Buteo p. platypterus* (G.H. Ragsdale); Dallas, Dallas Co. (J. Boll); 5 miles N.E. of Nacogdoches, Nacogdoches Co., on *Otus a. asio,* May 3 (H.E. Broadbooks); Eagle Lake, Colorado Co., on *Buteo l. lineatus* (R.H. Baker); 6 mi. E. of Carthage, Panola Co., on *Strix varia georgica* (P.W. Parmalee). — Vermont (recorded by Johnson, 1922): without precise locality, on *Accipiter striatus velox;* Dunmore Lake, Addison Co., on *Buteo l. lineatus* (C.E. Brown); Marlboro, Windham Co., on *Bonasa u. umbellus* (J.W. Rehn). — Virginia (recorded by Mosby and Handley, 1943, as *Olfersia* sp.): [Culpeper, Culpeper Co., on *Buteo jamaicensis borealis,* Nov. 15 (R.T. Mitchell, *in litt.;* not seen]; George Washington Nat. For., Harrisonburg, Rockingham Co., on *Aquila chrysaëtos canadensis* (T.E. Clarke); Whitetop Mt., Grayson Co. (A. Wetmore); Bush Hill near Franconia, Fairfax Co., on *Buteo l. lineatus,* Nov. 28 (B.G. Gunnell); Nelson Co., on 2 *Accipiter cooperii,* Dec. 28 and Feb. 1, and 2 *Bubo v. virginianus,* Jan. 4 and Aug. 11 (W. Robinson); East Falls Church, Arlington Co., on *Bubo v. virginianus,* Sept. 28 (C. Rohwer); Urbanna, Middlesex Co.; Lorton, Fairfax Co., on *Accipi-*

ter striatus velox; Thornton River, Shenandoah National Forest, on *Bonasa u. umbellus,* Sept. 26 (A. Wetmore); Emporia, Greensville Co., on wild *Meleagris gallopavo silvestris,* 2 ♀, Aug. 1. 1940 (H.S. Mosby); Amherst, Amherst Co., on *Bonasa u. umbellus,* Jan. 11 (T.P. Jackson). — WASHINGTON (STATE): Wawawai, Whitman Co., on *Otus asio macfarlanei* (F. Rotter) and *Bubo virginianus pacificus* (S.D. Beck); Walla Walla, Walla Walla Co. (Capt. Bendire); Pullman, Whitman Co., on *Bubo virginianus pacificus,* May 11 (G.E. Hudson).—WEST VIRGINIA: without precise locality, on *Bonasa u. umbellus;* Huntington, Cabell Co., on *Bubo v. virginianus* (F. Gilbert); Kingwood, Preston Co., on owl; Morgantown, Monongalia Co., on *Strix v. varia,* Sept. 12 (E.B. Marshall). — WISCONSIN (recorded by van der Wulp, 1867; Gross, 1931; MacArthur, 1948): without precise locality, on *Bonasa u. umbellus* (R. Rausch), and on *Colinus v. virginianus;* Portage, Columbia Co., on *Bubo v. virginianus* (K.P. Schmidt); Madison, Dane Co., on 2 *Bubo v. virginianus* (M. Deusing; E.M. Searls, Nov. 13) and *Strix v. varia* (P.W. Hoffmann); Rusk Co., on *Bonasa u. umbellus,* Sept. 29 (R.S. Dorney); Owen, Clark Co., on *Bonasa u. umbellus,* Oct. 26 (F.R. Zimmerman); Wausau, Marathon Co., on *Bonasa u. umbellus* (W. Knoll); Maiden Rock, Pierce Co.; Prescott, Pierce Co., on hawk; Cedar Grove, Sheboygan Co., on *Accipiter gentilis atricapillus,* Sept. 26, and *Accipiter striatus velox,* Sept. 25 (D.D. Berger), on *Accipiter cooperii* (L. Diederich), and on 2 *Buteo jamaicensis borealis* (L. Diederich; D.D. Berger, Sept. 26); Golden Lake, Jefferson Co., on *Bubo v. virginianus,* Jan. 1 (F.S. Schmidt); Lodi, Columbia Co., on *Bubo v. virginianus* (F. Hammerstrom); W. Spring Green, Sheboygan Co., on *Bubo virginianus wapacuthu* (W.M. Wheeler); Beaver Dam, Dodge Co. (H.L. Snyder); Rothschild, Marathon Co., on *Bonasa u. umbellus,* Oct. (R.J. Dicke); Ripon, Fond du Lac Co., on *Bubo virginianus wapacuthu* (W.M. Wheeler); Poynette, Columbia Co., on *Bubo v. virginianus,* Sept. 29, together with *Ornithoica vicina* (R. Rausch); Ozaukee Co., on *Bubo v. virginianus,* Oct. 31 (R. Boettger); 9 miles W. of Colby, Clark Co., on *Bubo v. virginianus,* Jan. 30 (H.W. and Lorna R. Levi). — An old specimen from the Loew Coll. (Mus. Comp. Zool.), without locality, is labeled "on wild turkey," *Meleagris gallopavo silvestris.*

MEXICO: Patzcuaro, State Michoacan, on owl, possibly *Otus asio* subsp. (P.S. Martin).

REPUBLIC OF HONDURAS: Zamorano, 20 miles from Tegucigalpa, on owl (Mrs. Margie Carr).

COSTA RICA: Turrialba, on hawk (E.W. Laake).

Panama: Sa. Clara, Chiriqui Prov., R.P., on *Bubo virginianus mayensis* (Mrs. M.E. McLellan Davidson); Juan Diaz, Panama Prov., R.P. (T. Hallinan).

Colombia (recorded without more precise locality as *O. fusca* by Macquart, 1845): without precise locality at Brit. Mus.; also Macquart's type of *fusca* from Bigot Coll., now in J.E. Collin Coll.

Guiana (recorded by Falcoz, 1930, probably from French Guiana, as *L. fusca*).

Brazil (recorded by Bigot, 1885, as *O. fusciventris;* Bau, 1929, as *O. fusca;* Lutz, Neiva and da Costa Lima, 1915, as *O. nigra*): Santos, State São Paulo, on *Sterna* sp. (Juliani); Butantan, State São Paulo, on *Tyto alba tuidara* (Werner); Ypiranga, State São Paulo, on *Otus c. choliba* and 3 *Tyto alba tuidara* (J. Lima), and on *Pulsatrix perspicillata pulsatrix* (E. Dente); Monte Alegre, State São Paulo, on *Buteo m. magnirostris* (J. Lima); Quilombo, State São Paulo; Presidente Epitacio, State São Paulo (J. Lima); Castra, State Paraná (W. Garbe); Anapolis, State Goyaz, on *Speotyto cunicularia grallaria* (O. Pinto); Itaqui, State Rio Grande do Sul, on *Glaucidium b. brasilianum* (W. Garbe); Maria de Fé, State Minas Gerais, on *Speotyto cunicularia grallaria* (O. Pinto); Joinville near Humboldt, State Santa Catharina, on *Tyto alba tuidara* [recorded by Bequaert, 1943, erroneously as on *"Bubo crassirostris"*] (W. Ehrhardt); Nova Teutonia, Itá, State Santa Catharina, on *Buteo m. magnirostris* (F. Plaumann); City of São Paulo, on *Tyto alba tuidara* (G.A. Allen) [recorded by Bequaert, 1933, erroneously as from San José, California] and on *Rhinoptynx c. clamator* (J. Lima); Guarapuada, Rio Jordão, State Paraná, on *Speotyto cunicularia grallaria;* Cara Pintada, State Paraná, on *Otus c. choliba;* Vermelho, State Paraná, on *Strix hylophila;* Martinho Prado, State São Paulo, on "gavião" or fulvous-bellied kite (B.B. Amaral); Cantareira, State São Paulo, on *Ciccaba virgata borelliana* (L.R. Guimarães); Tabatinguera, State São Paulo.

Bolivia: Sa. Cruz de la Sierra, Prov. Sara, on *Glaucidium b. brasilianum* (J. Steinbach); Irupana, 200 Kilom. E. of La Paz, 2000 m., S. Yungas, on *Falco sparverius cinnamominus* (Künzel and Niethammer).

Argentina (recorded by Falcoz, 1930, as *L. fusca*): Deseado, Misiones, on *Columba rufina sylvestris* (S. Pierotti); Misiones (E. Kivirikko); Agua Tapada near Hualfin, Catamarca, on *Caracara p. plancus,* July (S. Pierotti).

L. americana is a common New World fly with many breeding hosts. Massonnat's *Olfersia americana* (1909, p. 304), taken on

Platalea leucorodia in France, was certainly misidentified. Falcoz (1926, p. 31) described it later as a distinct species, *Lynchia massonnati;* but its true identity remains obscure. My attempts to trace the present whereabouts of the specimen have failed. I am inclined to regard it as identical with the African *Lynchia schoutedeni* J. Bequaert (1945*b*, p. 93).

The discussion of the distribution in Part I (p. 238, as *L. americana* and *L. fusca*) dealt mainly with the seasonal occurrence of the fly, so that some additional remarks are called for. In the Dominion of Canada, *L. americana* is as yet unknown from the western provinces and is rather rare in the East, where it occurs chiefly in southern Ontario. The northmost record (51° 33′ N.), dating from Walker (1849), needs confirmation, as all later Canadian captures are from 48° 50′ N. or farther south. These later Canadian records fit in with the northmost captures in the United States, particularly in North Dakota and Minnesota, none of which is from north of 48° 10′ N. Although there are relatively few records from Mexico and farther south, the species occurs throughout the continental part of the Neotropical Region, as far as 30° S. I have not seen it from the Antilles and there is no reliable record from that area.[44]

Known Nearctic Hosts of *L. americana* (verified individual records in parentheses). Ciconiiformes (1) : *Casmerodius albus egretta* (1). Falconiformes (132 and 10 undetermined hawks) : *Accipiter cooperii* (30) ; *A. gentilis atricapillus* (9) ; *A. striatus velox* (13) ; *Aquila chrysaëtos canadensis* (4) ; *Buteo jamaicencis borealis* (40) ; *B. jamaicensis calurus* (2) ; *B. lagopus sancti-johannis* (1) ; *B. l. lineatus* (13) ; *B. lineatus alleni* (1) ; *B. p. platypterus* (9) ; *Circus cyaneus hudsonius* (4) ; *Falco c. columbarius* (1) ; *F. peregrinus anatum* (1) ; *Haliaeëtus l. leucocephalus* (3) ; *Pandion haliaetus carolinensis* (1). Galliformes (82) : *Bonasa u. umbellus* (54) ; *B. umbellus togata* (3) ; *Colinus v. virginianus* (9) ; **Gallus gallus bankiva* (1) ; *Meleagris gallopavo silvestris* (wild; 5) ; *Pedioecetes phasianellus campestris; *Phasianus colchicus* (10). Charadriiformes (1) : *Uria l. lomvia* (1). Columbiformes (1) : *Zenaidura*

[44] O'Connor and Beatty (1938, Trans. Roy. Soc. Trop. Med. Hyg., London, **31**, pt. 4, p. 410) mention *Olfersia americana* as occurring in St. Croix on *Columbigallina passerina nigrirostris,* but almost certainly by error. *L. americana* occurs very rarely on Columbidae and as a stray only. The fly on the *Columbigallina* was probably either *Ornithoctona erythrocephala* or *Microlynchia pusilla,* both of which are known to occur on wild doves in St. Croix.

macroura carolinensis (1). Strigiformes (238 and 17 undetermined owls) : *Aegolius a. acadicus* (1) ; *Asio wilsonianus* (9) ; *Bubo v. virginianus* (113) ; *B. virginianus pacificus* (19) ; *B. virginianus pallescens* (3) ; *B. virginianus saturatus* (2) ; *B. virginianus wapacuthu* (3) ; *Otus a. asio* (7) ; *O. asio bendirei* (7) ; *O. asio brewsteri* (2) ; *O. asio floridanus* (7) ; *O. asio kennicottii* (1) ; *O. asio mccallii; O. asio marfarlanei* (2) ; *O. asio naevius* (7) ; *O. asio quercinus* (3) ; *Speotyto cunicularia hypugaea* (2) ; *Strix n. nebulosa* (1) ; *S. occidentalis caurina* (2) ; *S. occidentalis lucida* (1) ; *S. v. varia* (30) ; *S. varia georgica* (9) ; *Tyto alba pratincola* (7). Piciformes (1) : *Dryocopus pileatus abieticola* (1). Passeriformes (6) : **Calocitta f. formosa* (1) ; *Corvus b. branchyrhynchos* (3) ; *C. ossifragus* (1) ; *Zonotrichia albicollis* (1). To the Charadriiformes should be added *Philohela minor*, on which the fly was taken at South Amherst, Massachusetts, Oct. 18 (W.G. Sheldon).

Known Neotropical Hosts of *L. americana.* Falconiformes (4 and 2 undetermined hawks) : *Buteo m. magnirostris* (2) ; *Caracara p. plancus* (1) ; *Falco sparverius cinnamominus* (1). Charadriiformes (1) : *Sterna* sp. (1). Columbiformes (1) : *Columba rufina sylvestris* (1). Strigiformes (18 and 2 undetermined owls) : *Bubo virginianus mayensis* (1) ; *Ciccaba virgata borelliana* (1) ; *Glaucidium b. brasilianum* (2) ; *Otus c. choliba* (2) ; *Pulsatrix perspicillata pulsatrix* (1) ; *Rhinoptynx c. clamator* (1) ; *Speotyto cunicularia grallaria* (3) ; *Strix hylophila* (1) ; *Tyto alba tuidara* (6).

Bionomics. The list of 45 native and 3 introduced New World host species and 518 verified individual records of *L. americana* looks impressive, but gives only a partial idea of the frequency and density of infestation on different types of hosts. It is conclusive enough in showing that only Falconiformes, Galliformes and Strigiformes are true breeding hosts. The few reported occurrences on other types of birds are clearly abnormal and due either to natural straying or, more often, to *post mortem* contaminations. In the Nearctic Region, where the fly is reported from 33 native and 3 introduced host species, 97 per cent of the 490 verified records are from the 3 orders mentioned above. The Strigiformes lead with 52 per cent of the records, followed by the Falconiformes with 28 per cent and the Galliformes with 17 per cent. It should not be concluded from this that birds of prey are more favored as hosts than game birds or that owls are preferred to diurnal Raptores. The many records from owls may be due to the flies being more easily obtained from them than from diurnal birds of prey. The relative paucity of records from game birds is explained by the habit many collectors have of

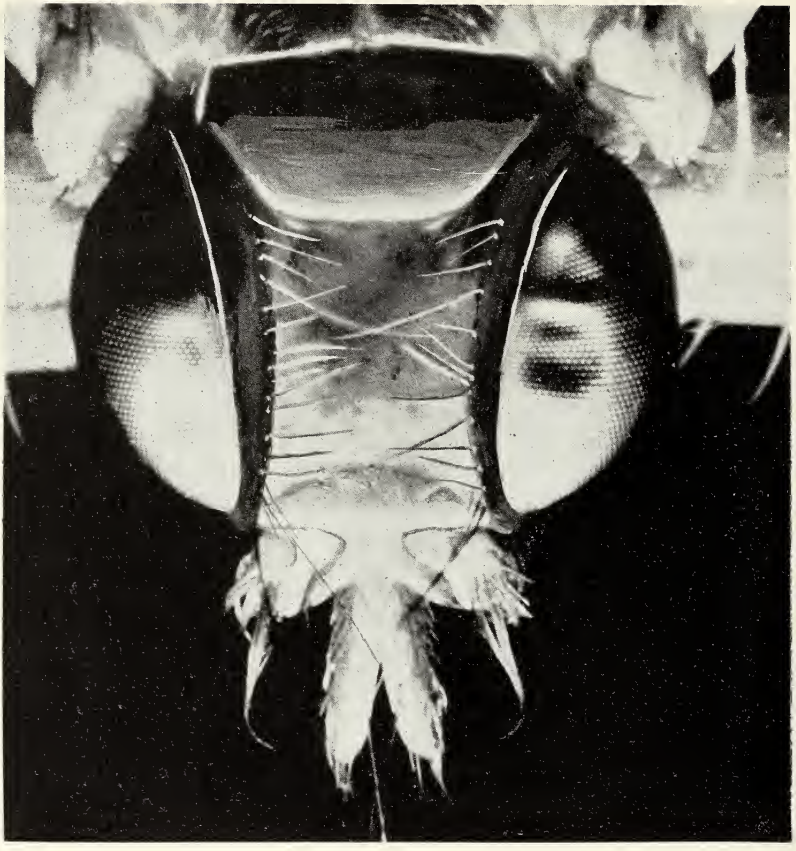

Fig. 54. *Lynchia americana* (Leach), head, ♀. Photograph by Mr. K. MacArthur (1948, fig. 245).

pooling flies from several such birds. The ruffed grouse, *Bonasa umbellus*, is actually as frequently infested as any of the birds of prey and serves, moreover, as an important winter host of the fly (Part I, p. 232). I am indebted to Dr. L. Penner for the following pertinent additional evidence. During October and November, 1951, 1952 and 1953, he found at Tolland, Connecticut, flies on 18 out of 36 ruffed grouse examined, the dates of capture being evenly spaced from Oct. 10 to Nov. 17. He also observed a fly-infested grouse on February 18, 1953. Individual infestations were light on these 19 birds, 10 carrying 1, 5 carrying 2, 3 carrying 3, and 1 carrying 5 flies. I suspect that the wild turkey was at one time and is perhaps

even now an important, regular host of *L. americana;* but the present restricted range and protected status of this bird make the collecting of its ectoparasites difficult. It is also of much interest that the introduced Asiatic pheasant has become a regular, acquired new host of the fly in the eastern United States. Dr. L.R. Penner has furnished the following information on infestation with *L. americana* of pheasant on Robbin's Island (in Greater Peconic Bay), New York. In 1947 the island was considered to have no game birds at all. It was then stocked with some 3000 pheasants. In June, 1951, when Dr. Penner visited it, the remaining adult pheasant population was estimated at some 500 birds. On July 27 and 28 he removed 6 live adult birds to his laboratory in Connecticut, *L. americana* being later found on 3 of them, 1 fly in 2 cases and 2 flies in the third. One of the 4 flies deposited a larva on July 8. As no grouse or quail were present on the island at the time of the visit, Dr. Penner regards the pheasant as the fly's natural host there.

C.W. Johnson (1925c, p. 52) was of the opinion that, in the eastern United States, *L. americana* was primarily a parasite of birds of prey and especially of certain owls, because it is often abundant on such birds. He regarded its occurrence on grouse as more accidental. From the observations recorded above I am inclined to regard native gallinaceous birds as the original hosts, from which owls and diurnal Raptores acquired the fly later by preying on game birds. The reverse process of game birds acquiring a regular fly parasite from their predators seems less probable.

I am also indebted to Dr. L.R. Penner for the following observations on experimental feeding. On October 29, 1952, he fed 7 *L. americana,* taken from two ruffed grouse, on a domestic pigeon. They fed readily, taking less than 5 minutes to engorge. Four flies, kept in vials after being fed on the pigeon, fed a second time. On October 30, 5 of the original 7 flies fed to satiation. Ordinarily the flies had no hesitation in feeding from chambers made for the purpose. Flies left on the pigeon could be located on the under side of the wings; but the pigeons pecked at them and possibly ate some, as not all of the flies were recovered. The body of the fly is tilted forward in feeding, with the hind legs lifting up the rear. The region near the vent of the pigeon was found most suitable for feeding the flies.

The records of *L. americana* from Central and South America are as yet too few to be fully trusted. Nevertheless it may be significant that the majority of Neotropical host species (9 out of 14, with 20 of the 28 individual records) are Strigiformes. That there

are fewer records from diurnal Raptores and none from gallinaceous birds can hardly be fortuitous, as other hippoboscids have been taken in some numbers on such birds in tropical America. Possibly other bird-flies, such as *Lynchia nigra* on Falconiformes and *Olfersia coriacea* on Galliformes, compete more successfully with *L. americana* on these hosts. In line with this, *L. americana* is also rare or lacking on Falconiformes in the western and southern United States, where diurnal Raptores are frequently infested with *L. nigra,* a fly occurring only accidentally in the northeastern states. In this connection it would be worthwhile to investigate the Mexican wild turkey, *Meleagris g. gallopavo* (= *mexicanus*), on which no hippoboscid has been taken thus far.

Although it has sometimes been mentioned in print, the puparium of *L. americana* was thus far undescribed. The following account is based on specimens obtained from flies on owls in California, on *Accipiter cooperii* in Massachusetts, on *Asio wilsonianus* in New Jersey, and on *Bubo v. virginianus* in Ontario, New York, Pennsylvania and South Carolina. When normally developed, it is broadly and almost regularly elliptical, scarcely narrower posteriorly, moderately depressed and equally convex dorsally and ventrally, 4.4 mm. long, 3.2 mm. wide and 2.5 mm. thick (Fig. 53*L–N*). The hexagonal cap, bearing the polypneustic lobes at the posterior end, has broadly rounded angles and is divided into halves by a very shallow sinus with a deeper, narrow longitudinal groove in the bottom; near each side of this groove a depression bears the minute circular scar of the stigma of the second larval instar. The halves of the cap do not show the usual 3 broad, low, radiating ridges separated by shallow depressions (of *Ornithomyia,* for instance). Instead each half is fairly uniformly and densely covered with minute punctures and bears close to the outer margin three groups of small pores on raised tubercles. The pores of each group form a broad, irregular curve or bow, convex toward the outer margin and ending widely open far from the center of the cap. The remainder of the puparium is bare and shiny, the integument with a close, irregular network of microscopic engraved lines. Traces of transverse segmentation and of lateral depressions running lengthwise are visible in newly-voided larvae, but not in the fully-formed puparium.

The conditions under which the larvae are voided are as yet obscure. It is by no means certain that the puparia are normally found in the feathers of all types of hosts, as Champlain (1947) and others have observed for the great horned owl. The soft, dense plumage of owls offers ideal conditions for sheltering and retaining

hippoboscid puparia; but these conditions are not duplicated by the plumage of diurnal birds of prey and game birds. A *L. americana* taken from the ruffed grouse on October 9, at Princeton, Massachusetts, deposited a larva in the collector's hand (C. W. Johnson, 1929, p. 51). On December 21, 4 ♀♀ and 2 puparia were collected from a great horned owl at Baldwinsville, N. Y. It would appear that in *L. americana* reproduction proceeds normally on certain hosts during late fall and early winter in temperate America, or even the year round where winters are mild.

Aspects of the life-history of *L. americana* (or its synonym, *L. fusca*) discussed in Part I include infestation with mites (pp. 157–158), phoresy of Mallophaga (p. 172), larviposition (p. 194), duration of pupal development (p. 199), interspecific competition on the host (p. 223), seasonal fluctuations (p. 238), and density of populations (p. 232). It is one of the few hippoboscids definitely known as a permanent, year-round member in the adult state of the temperate fauna of North America. It may be taken at all seasons on the 3 orders of birds containing breeding hosts, but is particularly common on owls from November to March. The dates of captures in various areas also show that it is a permanent parasite over most of its geographical range.

Herms and Kadner's experiments with *L. americana* (as *L. fusca*) in the transmission of *Haemoproteus lophortyx* from quail to quail were mentioned in Part I (p. 360). It was pointed out that they had little if any bearing on the transmission of this blood parasite in nature, as *L. americana* has never been taken on wild quail in California, in spite of the many hundreds of hippoboscids collected from these birds. In a recent textbook (1950, p. 414) Herms adds that in captivity "*L. fusca*" feeds readily on quail and deposits mature larvae freely when fed on them. No evidence has been offered thus far that *L. americana* transmits a blood parasite either to ruffed grouse or to any of its other true hosts in nature.

Affinities. My earlier accounts of the larger species of *Lynchia* (1933*b*, 1945*b*) recognized *L. fusca* (Macquart) as specifically distinct from *L. americana*, the former believed to occur mainly in western North America and south of the Mexican border and the latter to be restricted to the eastern Nearctic Region. It also seemed at that time that the two forms differed somewhat in host preferences, *L. fusca* being thought to be more specific of owls. Later studies of over 1500 specimens, including several large lots from individual hosts, made it increasingly difficult, however, to distinguish these two forms in all cases. Repeated attempts to find fully reliable

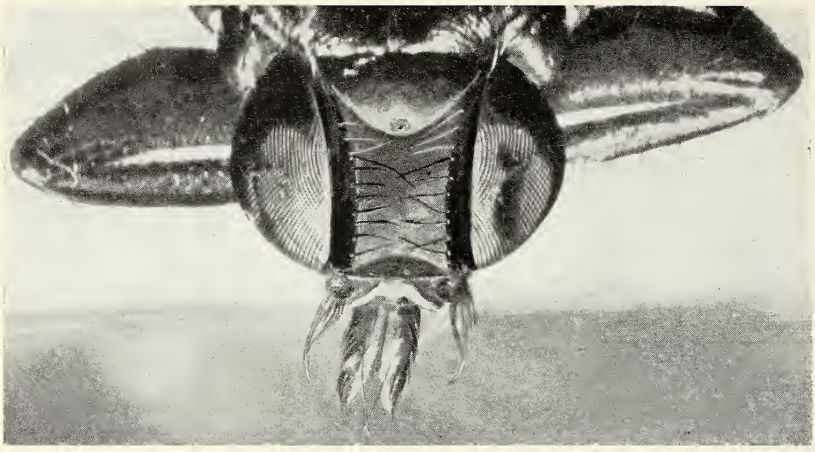

Fig. 55. *Lynchia americana* (Leach), head, ♀, Brooksville, Fla., on *Otus asio floridanus*. Photograph by Mr. K. MacArthur (1948, fig. 246, as *L. fusca*).

specific differences have failed and it now seems impossible to recognize more than one species among the large American *Lynchia* with few orbital bristles placed in a single row and with the interocular face much wider than an eye. It follows that the supposed differences in distribution and host preferences are no longer tenable.[45]

Of the characters formerly believed to separate *L. fusca* and *L. americana*, the shape of the smooth postvertex seemed at first to be most reliable, and the difference between the two extreme types (Fig. 53*E* and Fig. 53*K*) is indeed striking. In one the postvertex is transverse, considerably (up to 5 times) wider than long, with a rather straight anterior margin longer than either of the sides. In the other, it is more semi-elliptical, often barely 3 times as wide as long, with a more or less convex anterior margin not, or scarcely, longer than either of the sides. Many flies readily fall in two groups based on this character; but others are clearly transitional. In this connection it may be noted that in Leach's type of *L. americana* the postvertex is about mid-way between the two extremes (Fig. 53*A*); so that, if two species were recognized by the shape of the postvertex, this type would have to be placed arbitrarily. Moreover, a study of the postvertex in long series from individual hosts, easily obtained

[45] In Part I of the present work the discussion of various aspects of the natural history of *L. americana* and *L. fusca* was based on the concept that they were distinct species. It should be revised to conform with the new view presented here.

in this species, shows conclusively that the variations in shape are due to individual or fluctuating variability in natural interbreeding populations, hence have no specific or subspecific significance. A series of 61 flies taken from one great horned owl, at Ellis Hollow near Ithaca, by Dr. C. E. Palm (J. Bequaert, 1945*a*) was particularly instructive, showing all gradations from the transverse to the semi-elliptical type (Fig. 53*F–H*).

It was thought at one time that the shape of the interocular face might be more reliable than that of the postvertex. In my key of 1945 I described *L. americana* with the "inner margins of eyes strongly diverging to the postvertex;" and *L. fusca* with the "inner margins of eyes subparallel or slightly diverging." There are, however, so many seemingly haphazard variations in this respect that the difference is clearly of no specific value. Other possible specific differences, such as the relative length and width of the interocular face, the shape or relative width of the inner orbits, and the presence or absence of an anterior pit (rudimentary ocellar depression) on the postvertex, were also investigated and found unreliable.

The venation appears to be on the whole more stable in *L. americana* than in some other hippoboscids. The 1st longitudinal vein ends in the costa decidedly basad of the anterior cross-vein (Fig. 14*F*; Ferris, 1930*c*, p. 68, fig. 5*A*). The subcosta varies relatively little, being normally incomplete. In 384 of 397 flies it is incomplete in both wings, either ending abruptly some distance from the costa or fading gradually in the membrane; in 10 flies it is incomplete in one wing and complete to the costa in the other; and in 2 flies it is complete in both wings (1 of 10 flies from one *Accipiter cooperii*, Kittery Point; 1 from *Bubo virginianus pacificus*, Pullman). In one fly, from Delmar, on *Buteo l. lineatus*, the subcosta is incomplete as usual in one wing, while in the other it is connected not with the costa, but with the 1st longitudinal at a point slightly basad of the anterior basal cross-vein.

Apart from the terminalia (Figs. 52*F–G*), there is very little difference between the sexes; but the abdomen of the ♀ bears ventrally a group of long setae bunched on a raised, soft, not sclerotized knob, between the 7th abdominal spiracle and the vulvo-anal sclerites (Fig. 52*F*, *kn*); the ♂ lacks this setigerous knob. In some males the interocular face appears slightly narrower than in most females; but usually the difference is scarcely noticeable (Figs. 53*O–P*). The single antero-median tergal sclerite is present in both sexes and of about the same shape and size.

Original description of *F. americana* (1817, p. 11): "F. lutescens, thorace angulis anticis in tubercula obtusa productis, alis subiricoloribus. Caput lutescens: oculi atro-nigri: antennae nigricantes: labium album: haustellum luteum: vagina [palpi] picea pilis nigris obtecta: clypeus [frons] subquadratus luteus antice late emarginatus; laciniis divaricatis [apical arms of frons] acuminatis: frons [mediovertex] brunneo-lutea; marginibus elevatis [inner orbits] glaberrimis: vertex [postvertex] elevatus glaberrimus luteus. Thorax subbrunneo-luteus obscurius irregulariter strigosus depressione cruciforme notatus: scutellum subbrunneo-luteum medio impressum: pectus pallidum glabrum medio sulcatum lateribus subcrenulatis, antice bifurcatum; laciniis rotundatis: alae subiricolores: pterigostea [veins] picea et lutea: pedes lutea: tarsi obscuriores: ungues nigri. Abdomen flavo-luteum punctulis nigris sparsum, basi medioque supra obscurius." On p. 6 there is also a brief diagnosis: "Lutescens, thorace angulis anticis in tubercula obtusa productis, alis subiricoloribus." The type, a female from the Francillon Collection, now at the British Museum, was seen in 1933 and again in 1951. It agrees in every respect with my concept of the species, showing the specific characters given in my key. According to a camera lucida sketch by Dr. G. B. Fairchild (Fig. 53*A*), the postvertex is about 3 times as wide as long, with the convex anterior margin about as long as the sides. Leach gave no measurements; but the right wing of the type is 8.3 mm. long, in agreement with Leach's fig. 1, drawn natural size. The subcosta is incomplete in both wings.

Original description of *H. bubonis* (1869, p. 417, footnote): "Female. Uniform horn color, with a reddish tinge and blackish hairs; legs paler, with dark tarsi; body beneath paler; tip of abdomen black, with long bristles. Length of body .30 inch [=7.6 mm.]; of a wing .34 inch [=8.6 mm.]. Differs from *H. equinae* in being larger, and in its uniform reddish color." The type, originally at the Peabody Academy of Sciences in Salem, Massachusetts, is now at the Museum of Comparative Zoölogy. It is in very poor condition, having lost both head and abdomen. There is no doubt, nevertheless, that it is the common *L. americana*, as Osten Sacken (1878) first recognized. The wing is 8 mm. long.

Original description of *O. fusca* (French text translated): "Fusca. Alis fuscanis. Long. 2 [French] lines [=4.5 mm.]. Body entirely brown." It would, of course, be impossible to attempt to recognize the species from this description. Fortunately the type was the property of Bigot (as mentioned by Macquart) and is now in the J. E. Collin Collection. It was first seen by Speiser (1902), whose notes follow (translated from the German): "Length 4.5 mm., from oral margin to hind margin of scutellum 3 mm. Uniformly russet-brown, somewhat shiny, the base of the proboscis beneath and the lower face at the sides of the antennal pits yellowish-brown. Wings smoky-brown. Frons [interocular face] a little wider behind than in front, the inner margins of the eyes therefore not exactly parallel. Occiput evenly rounded; occipital triangle [postvertex] wider, but only about twice as wide as long, with a slight, pit-like, deepened notch in the middle of the anterior margin (difference as compared with *O. macquartii* Rondani). The raised and smooth margins of the eyes [inner orbits] with a deeper impression shortly behind mid-length; in front of this impression stands a seta, as usual in *Olfersia* [=*Lynchia*] and from this a row of punctations runs forward, the whole forming a kind of furrow. Clypeus [frons] short, the upper margin only with a weakly indicated small pit, distinctly divided transversely, the anterior portion ending in two very short diverging points. Maxillary palpi elongate, as long as the anterior width of the frons [interocular face] and somewhat over half the length of the head; slightly curved downward, dark brownish-yellow with blackish-brown lower edge. Thorax rounded, with humeral angles only slightly projecting, a fine longitudinal suture [median notal suture] and a continuous, medially uninterrupted transverse suture [transverse mesonotal suture]. Scutellum of the

usual shape, uniformly russet-brown throughout; the center is damaged, so that nothing can be said about the presence or absence of a furrow. Legs without peculiarities; femora not paler basally than the remainder of the abdomen. Subcostalis [1st longitudinal] ending before [basad of] the small cross-vein [anterior cross-vein]; radialis [2nd longitudinal] ending closer to the cubitalis [3rd longitudinal] than to the subcostalis [1st longitudinal]; last section of costa only half the length of the penultimate, not thickened; posterior [second] basal cell less than half the length of the anterior [first], suddenly widened at the elbow of the discoidalis [4th longitudinal], where it is narrower than its distance from the anterior margin of the wing. Starting point of the discoidalis [4th longitudinal] only slightly raised and knob-like. Abdomen without peculiarities; first segment and sides dark-brown.'' I examined the type in 1951 and found that it agreed with what I had been calling *L. fusca* since 1933. This had been surmised from Speiser's remarks, particularly his description of the postvertex and of the short row of punctations on the inner orbits, the punctations being the insertions of the smaller orbital bristles. The sex of the type could not be determined. I now no longer recognize *L. fusca* as distinct from *L. americana.*

Original description of *O. rufiventris* (French text translated): "Long. 7 mm. Nigro nitido. Haustello rufo, palpis obscure castaneis; fronte media, spatio quadrato magno, opaco, vertice parum cordiformi, marginibus internis oculorum et epistomate, nitidis; oculis pallide rufis; tergo thoracis et scutello, linea longitudinali media profunde notatis; abdomine rufo pruinoso, macula basali parva, et, apicem versus, maculis duo rotundatis, nigris nitidis picto; pedibus omnino nigris, nitidis; alis infuscatis; vena transversa 2a, vix perspicua, a 1a longe locata. Proboscis russet; palpi dark brown; eyes pale reddish; frons [interocular face] medially with a large dull, quadrangular, depressed area [mediovertex] between the narrow and shiny projections of the inner margins of the orbits and extending from the anteriorly notched vertex [postvertex] to the epistome [frons]; a longitudinal groove over middle of tergum and scutellum [median notal suture]; abdomen russet, pruinose, with a small, black and shiny, projecting spot near the base and two other, larger, rounded, similar spots near the apex; legs entirely shiny black; wings blackish; two basal cells very unequal, the 2nd or inner cross-vein [anterior basal cross-vein] poorly defined and placed close to base of wing; 1st longitudinal vein of Rondani [true 1st longitudinal, not Rondani's] united with the costa basad of 1st or outer cross-vein [anterior cross-vein]; 2nd and 3rd longitudinal veins [2nd and 3rd longitudinals] ending close together, but very far from 1st longitudinal.'' Originally described from 4 specimens, all now in the J. E. Collin Collection. Speiser (1902) recognized that they belonged in *Lynchia* (Speiser's *Olfersia*), not in *Ornithomyia* as Bigot thought, and were closely related to *O. fusca* Macquart. He believed that *rufiventris* differed from *fusca* in the larger size and in the ''contour of the vertex'' [postvertex], adding the following remarks (translated from the German): ''Length 5.5 to 7.5 mm., from oral margin to hind margin of scutellum 3.5 to 3.75 mm. Color as in *O. fusca* Mcq.; only the side corners of the scutellum are somewhat more yellowish-brown than the remainder of the thorax and the reddish middle line is more distinct. The frons [interocular face] is quite parallel-sided, not narrower in front than behind; vertical triangle [postvertex] in this case also with a small pit notching the anterior margin.'' In 1951 I made a careful study of the 4 types of *rufiventris* and was unable to find a reliable character to separate them from the type of *fusca,* with which I compared them. The apparent difference in size is due mainly to the shrunken abdomen of the type of *fusca.* The body size, moreover, varies within the series of *rufiventris;* but the variation in the length of the wing is well within the limits known for *L. americana* (7 to 8 mm.). The sex of the types of *rufiventris* was not determined.

Original description of *O. macquartii*: ''Long. 5 mm. Nigricante-picea:

proboscide lutescente, basi crassiuscula et in linguam filiformem elongata. Palpi elongati, sub-erecti, nigricantes, sub-conici. Frons [true frons] non distincte foveolata nec punctis impressis signata, labio supra os sub-lutescente: orbitis angustis [inner orbits] et areola verticis [postvertex] levibus nitentibus; area verticale [postvertex] antice in medio incisa et in specimine nostro paulo ferruginante. Thorax in dorso cum scutello nitens. Abdomen nigricans, opacum, nigro-setigerum, lateribus et basi pallidis. Alae fuscae, venis obscure subluteis; abdomine duplo et ultra longiores; vena prima longitudinale [subcosta, not the true 1st longitudinal] contra transversum interiorem [anterior basal cross-vein]; tertia [2nd longitudinal] in costale satis remota a secunda [1st longitudinal] et proxima quartae [3rd longitudinal]; transversa interiore [anterior basal cross-vein] dimidiata, non obliqua. Pedes fusci, femoribus basi paulo lurida glaucis." Rondani based his description on a specimen which he had received from Macquart labelled "*O. fusca,*" but he believed it was a distinct species, as it did not agree with Macquart's description. According to information kindly supplied by Dr. Benedetto Lanza (*in litt.,* 1953), the type of *O. macquartii* is now in Rondani's collection, preserved in the Natural History Museum at Florence (under No. 3410). So far as I know, it was not examined since it was described. Speiser's incidental remark, in his discussion of *O. fusca* (1902), does not seem to have been based on a study of Rondani's type. It seems most probable that *O. macquartii* was based on a specimen of Macquart's *fusca;* like the latter, it may confidently be placed in the synonymy of *L. americana.*

Lynchia latifacies, new species

Figs. 56*A–E*

Male. Head (Fig. 56*C*) in front view about $1\frac{1}{6}$ times as wide across eyes as high from occipital margin to tips of apical arms of frons. Interocular face at its narrowest about $1\frac{3}{4}$ times the width of an eye, nearly as high along inner orbits as its greatest width at postvertex, the sides moderately converging toward lower third. Inner orbits nearly half as wide as mediovertex at its narrowest; inner orbital bristles few, mostly weak: a lower group of 3 or 4 (1 stiff and long) near lunula; an irregular row of 5 or 6 (none very long) at about mid-height of face; 1 stiff, rather short vertical bristle on each side. Postvertex wider than long, though relatively longer than usual, rhombiform; depressed anterior margin slightly wavy, about as long as each side in which it curves gradually; no traces of rudimentary ocelli, but instead a superficial median pit near the center. Frons: lunula and interantennal area separated by a deep, furrowed, transverse suture; lunula with a minute antero-median pit; basal portion of interantennal area broad, nearly as wide as its distance from inner eye margin, nearly as long as lunula; apical emargination very broad, the sides forming 2 short, sharply pointed, but not prong-like arms which reach just beyond the antennae. Antenna short: 1st segment almost completely fused with side of lunula, bearing a few short setae; 2nd segment twice as long as 1st along inner margin, very broadly rounded at apex, with 6 to 8 long,

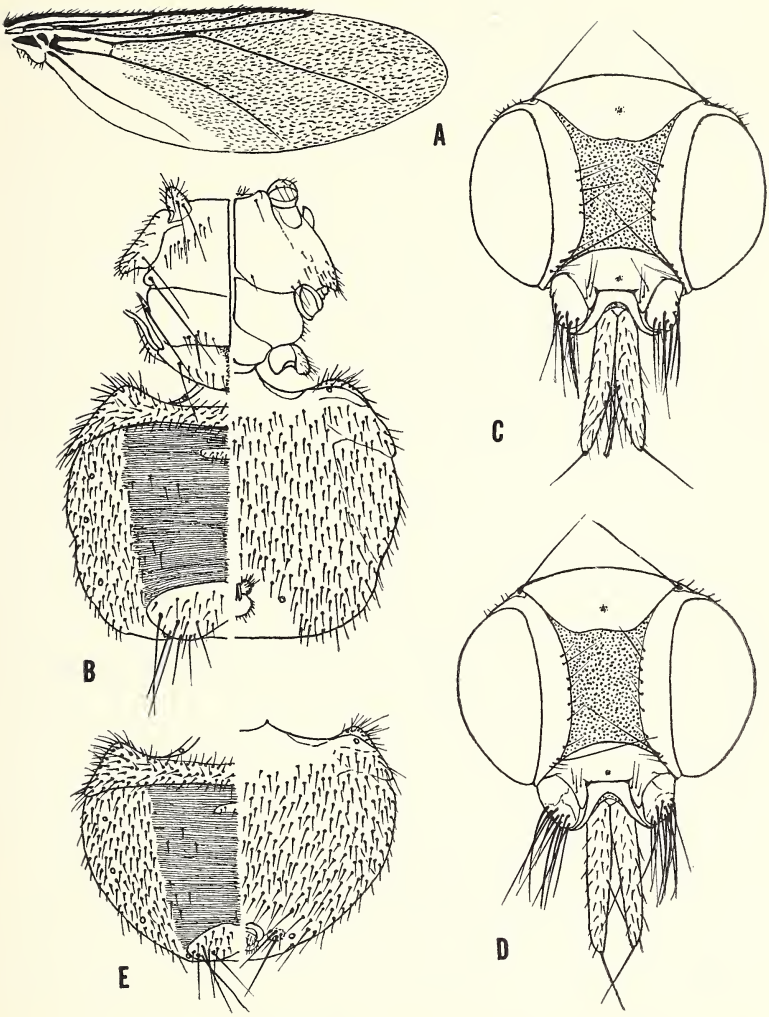

Fig. 56. *Lynchia latifacies* J. Bequaert, **A–C**, ♂ holotype, Tabatinguera, Brazil: **A**, wing; **B**, thorax and abdomen dorsally and ventrally; **C**, head. **D–E**, ♀ allotype, Paso Yobai, Paraguay, on *Piaya cayana:* **D**, head; **E**, abdomen dorsally and ventrally.

curved bristles. Palpi long, distinctly longer than mediovertex and than half the height of head. Thorax (Fig. 56*B*) dorsally: anterior margin nearly straight medially; humeral callosities decidedly longer than wide, fairly prominent, bluntly rounded at apex, with 2 long bristles and several short, stiff setae; mesonotum with 2 small, transverse patches of a few soft setulae on each side, one behind humeral callosity, the other before scutellum, the prescutellar patch with 1 rather short, stiff bristle; 1 very long notopleural and 1 similar postalar bristle on each side; dorsal anepisternum with scattered short setae and 1 long bristle behind mid-length. Scutellum semi-elliptical; hind margin moderately and evenly convex seen from above; blunt edge fringed with soft setulae; a few short preäpical setae at extreme sides; 1 short, rather weak discoscutellar bristle in each corner; surface with a shallow longitudinal groove, triangularly widened anteriorly, linear posteriorly. Metathoracic pleurotergite with a few short, stiff setae in a slanting row. No metasternal spurs near hind coxae. Legs rather long and slender; femora and tibiae with the usual long bristles, but only moderately setulose; 4th tarsal segment of fore legs normal. Wing (Fig. 56*A*) relatively long and narrow; microtrichia covering most of membrane, but bare over the following areas: entire postaxillary cell; most of basal half and apical hind third of combined anal, 3rd posterior and axillary cells; entire 2nd basal cell; and extreme base of 2nd posterior cell; costa moderately thickened beyond tip of 1st longitudinal vein; 2nd basal cell much less than half as long as 1st; anterior basal cross-vein nearly vertical and almost complete; costa and subcosta densely setulose; anterior cross-vein very short and thick; subcosta incomplete, but its tip only narrowly separated from costa, stopping basad of anterior basal cross-vein; 1st longitudinal vein ending in costa much basad of anterior cross-vein. Abdomen (Fig. 56*B*) dorsally with the usual transverse basal sclerite (fused laterotergites), triangularly produced behind at each side corner; a large, transverse, reniform preäpical sclerite, with a few scattered short setae and posteriorly on each side with 5 to 7 long, stiff bristles; median striolate dorsal area almost bare, with one small differentiated, smooth, median sclerite a short distance behind the basal laterotergites; soft areas of sides of dorsum and venter fairly uniformly covered with many moderately long and short setae on very small tubercles. Setigerous lobes at sides of genital atrium very small.

Length from tips of apical arms of frons to hind margin of scutellum, 3.5 mm.; of wing, 5.8 mm.; width of wing, 1.7 mm.; (total length of dry, pinned specimen, about 4.3 mm.).

Female (Figs. 56*D–E*) similar to the ♂, particularly in the relative width of the interocular face and of the inner orbits, and in the presence of one small, smooth median sclerite on the dorsum of the abdomen behind the basal laterotergites. Subcosta incomplete in both wings. Venter between the 7th abdominal spiracle and the ano-genital openings with a soft setigerous knob, lacking in the ♂.

Length from tips of apical arms of frons to hind margin of scutellum, 4 mm.; of wing, 7 mm.; width of wing, 2.3 mm.; (total length of dry, pinned specimen, about 5.3 mm.).

Brazil: Tabatinguera, State São Paulo, from unknown host, ♂ holotype (Mus. Comp. Zool., Cambridge, Mass., No. 29185).

Paraguay: Paso Yobai, Caaguazú, ♀ allotype, on *Piaya cayana macroura* (Foerster. — Fundación Miguel Lillo, Tucumán).

As the description and figures were made from dry flies, they will have to be revised later with fresh or alcoholic specimens. The species is intermediate in size between the large and the small *Lynchia*. Among the small species, it resembles *L. plaumanni* superficially, but differs particularly in the lack of rudimentary ocelli and the extent of the area covered with microtrichia in the wing. It appears to be closely related to *L. americana*, from which it may be separated by the somewhat smaller size and the few characters mentioned in the key.

The only known host belongs to the order Cuculiformes; but it would be premature to draw conclusions from the single host record.

Lynchia angustifrons (van der Wulp)

Figs. 57*A–C* and 58

Olfersia angustifrons van der Wulp, 1903, Biol. Centr.-Amer., Diptera, **2**, p. 430; Pl. 13, figs. 3–3*a* (♂ ♀; no host. Mexico: ♂ Teapa, State of Tabasco. Costa Rica: ♀ Río Sucio. Cotypes at Brit.Mus.). Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (types. Mexico: Oajaca). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Swenk, 1916, Jl. New York Ent. Soc., **24**, pp. 130 and 132 (Mexico: Motzorongo, State of Vera Cruz, on *Trogon* sp.).

Ornithoponus angustifrons Johnson, 1925, Occ. Papers Boston Soc. Nat. Hist., **7**, p. 294 (New Hampshire: Hampton).

Lynchia angustifrons Ferris, 1930, Canad. Entom., **72**, p. 68, figs. 5*E* and *G* (Panama: Camp Pital, Chiriqui Mts., on *Ramphastos swainsonii*). Dunn, 1934, Psyche, **41**, p. 175 (misspelled "*augustifrons*"). J. Bequaert, 1938, Carnegie Inst. Washington, Publ. No. **499**, p. 227; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1943, Jl. of Parasitology, **29**, pp. 132 and 134. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, pp. 412 and 419, fig. 247 (Wisconsin: Madison, Dane Co., on *Accipiter striatus velox*. Illinois: Herrin, on *Strix v. varia*. Minnesota: Little Falls, Morrison Co., on *Buteo p. platypterus*).

Olfersia fusca Ad. Lutz, Neiva and Costa Lima, 1915, Mem. Inst. Osw. Cruz, 7, p. 182 (Brazil: Est. São Paulo, on *Pitylus fuliginosus, Veniliornis affinis ruficeps* ["*Dendrobates rugiceps*"], *Glaucidium b. brasilianum* and *Baryphthengus r. ruficapillus* ["*Momotus rufescens*"]; Est. Rio de Janeiro, on *Glaucidium b. brasilianum*). Not of Macquart, 1845.

Distribution and Specimens Examined. Dominion of Canada. Ontario: Vineland, Lincoln Co., 43° 12′ N., on *Accipiter striatus velox* (W.G. Garlick).

United States. Illinois (recorded by MacArthur, 1948): Herrin, Williamson Co., on *Strix v. varia,* Oct. (N.A. Meinkoth). — Maryland: Bowie, Patuxent Research Refuge, Prince Georges Co., on *Accipiter cooperii* and *Buteo l. lineatus* (R.T.Mitchell). — Massachusetts: Easthampton, Hampshire Co., on *Accipiter striatus velox* (C.K. Merriam). — Michigan: Whitefish Pt., Chippewa Co. (Edna Brodkorb). — Minnesota (recorded by MacArthur, 1948): Little Falls, Morrison Co., on *Buteo p. platypterus* (G. Swanson). — Missouri: Columbia, Boone Co., on hawk (L. Jeffrey). — New Hampshire (recorded by Johnson, 1925): Hampton, Rockingham Co., May 13 (S. Shaw). — Pennsylvania: Forest Hill near Pittsburgh, on *Hylocichla mustelina* (R.H. Fricke). — Texas: 4 miles W. of Wells, Cherokee Co., on *Buteo p. platypterus.* — Virginia: Falls Church, Fairfax Co. (A. Wetmore). — Wisconsin (recorded by MacArthur, 1948): Madison, Dane Co., on *Accipiter striatus velox,* May 8 (R. Rausch).

Mexico (recorded by van der Wulp, 1903; Swenk, 1916): without precise locality, on *Accipiter striatus velox* (C.H. Merriam); Teapa, State Tabasco (H.H. Smith. — Cotype ♂ of *angustifrons*); State Oajaca; Laguna Ocotal, State Chiapas, ♀ and ♂ on *Hypomorphnus urubitinga ridgwayi* (R.A. Paynter, Jr.); Misantla, State Vera Cruz, on *Cathartes a. aura* (W. Engelmann); Xilitla, State San Luis Potosi, on *Momotus momota coeruliceps* (J. Newman); Motzorongo, State Vera Cruz, on *Trogon* sp. (L. Bruner); Cacahoatan, State Chiapas, on *Busarellus n. nigricollis* (Esc.N.C.Biol.); Las Nubes, 1200 m., State Chiapas, on *Ciccaba virgata centralis* (Esc.N.C.Biol.); Finca Esperanza, State Chiapas (P. Brodkorb); El Ocote, Ocozocoautla, State Chiapas, on *Micrastur ruficollis guerilla* (M. Alvarez del Toro).

British Honduras: El Cayo, on *Odontriorchis palliatus, Glaucidium brasilianum ridgwayi,* and *Ictinia plumbea* (J. Van Tyne).

Guatemala: Uaxactun, Peten, on *Accipiter b. bicolor* and *Ramphastos s. sulfuratus* (J. Van Tyne); Olas de Moca, Dept. Solola, on owl (G.P. Engelhardt).

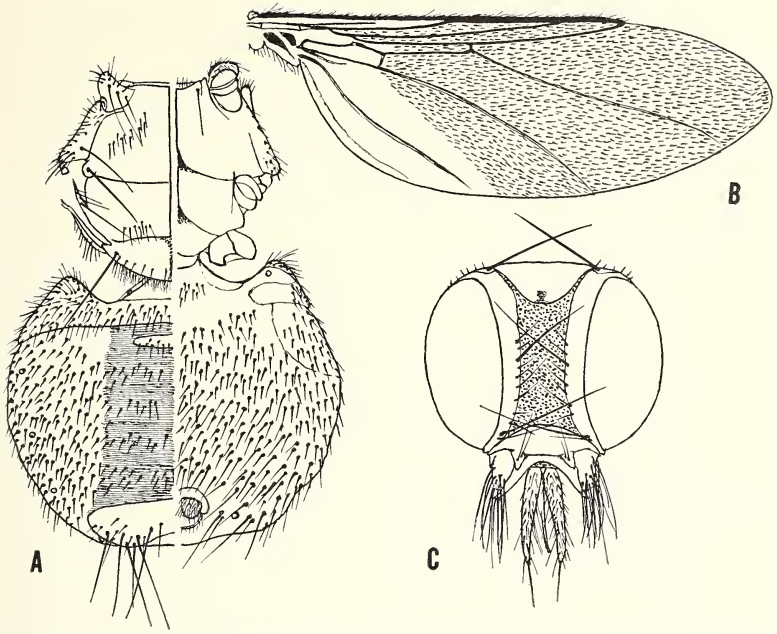

Fig. 57. *Lynchia angustifrons* (van der Wulp), ♀, Hampton, N.H.: **A**, thorax and abdomen dorsally and ventrally; **B**, wing; **C**, head.

Costa Rica (recorded by van der Wulp, 1903): Río Sucio (Rogers. — Cotype ♀ of *angustifrons*); Higuito, San Mateo (P. Schild).

Panama (recorded by Ferris, 1930; Dunn, 1934): Limestone Caves, Río Chillibrillo, C.Z. (T. Hallinan); Culebra, Arrijan Trail, C.Z. (T. Hallinan); Barro Colorado, C.Z., on *Leucopternis albicollis costaricensis* and *Ramphastos sulfuratus brevicarinatus* (J. Van Tyne); Alhajuelo, C.Z., on *Falco s. sparverius* (A. Busck); Camp Pital, Chiriqui Prov., R.P., on *Ramphastos swainsonii* (L. H. Dunn).

Colombia: Norosi, Depto. Bolivar, on *Micrastur semitorquatus naso* (M.A. Carriker, Jr.).

Venezuela: Mérida (Gehringer); Cariaquito, Dept. of Bermudez, State of Sucre (S. Brown).

British Guiana: Issororo, Northwestern District, on *Accipiter b. bicolor* (G.M. Vevens); Kartabo (W. Beebe); Paraweaka Creek, on hawk (C.E. Bodkin).

Brazil (recorded by Lutz, Neiva and da Costa Lima, 1915, as *O. fusca*): Joinville near Humboldt, State Santa Catharina, on

"*Bubo crassirostris*"[46] and *Elanus l. leucurus* (W. Ehrardt); Jundiahy, State São Paulo; Nova Teutonia near Itá, State Santa Catharina, on *Micrastur r. ruficollis* and *Ictinia plumbea* (F. Plaumann); Angra dos Reis, State Rio de Janeiro (L. Travassos); Iguassú, State Paraná, on *Ramphastos dicolorus* (Inst.Osw.Cruz); Varjão do Guaratuba, State São Paulo, on *Hypomorphnus u. urubitinga* (E. Dente); Fazenda Pinheiro, Lucelia, State São Paulo, on *Pteroglossus a. aracari* (Frisch); Juquia, State São Paulo, on *Buteo m. magnirostris* and *Cyanocorax caeruleus* (F. Dane); Ypiranga, State São Paulo, on *Pyroderus s. scutatus* (J. Lima); Rio Itaunas, Conceição da Barra, State Espirito Santo, on *Glaucidium b. brasilianum* (E. Dente); Fazenda Bom Retiro, Alem Paraiba, State Minas Gerais, on *Hypomorphnus u. urubitinga* (C. Lake); Rio Doce, State Minas Gerais, on *Micrastur r. ruficollis;* Floresta da Capela de S. Braz, Sa. Teresa, State Espirito Santo, on *Micrastur r. ruficollis* (C. Lako); Ilha do Cordoso, State São Paulo, on 2 *Milvago c. chimachima* and *Cyanocorax caeruleus;* Ubatuba, State São Paulo.

Paraguay: Paso Yobai, Caaguazú, on *Amazona aestiva xanthopteryx* (Foerster).

L. angustifrons is restricted to the New World, where it ranges from Minnesota, southern Ontario and New Hampshire to southern Brazil. The northmost record is from Minnesota (about 46° N.) and the southmost from the State of Santa Catharina (about 27° S.). It is essentially a Neotropical insect which strays fairly often to the Nearctic Region with some of its migratory hosts, though it is only a summer resident there. The few birds on which it has been taken in the United States and Canada, 6 species in all, occur also farther south, at least during the winter. *L. angustifrons* will eventually be recognized as a common bird-fly throughout tropical Central and South America.

Known Nearctic Hosts of *L. angustifrons* (verified individual records in parentheses). Falconiformes (7 and 1 unidentified hawk): *Accipiter cooperii* (1); *A. striatus velox* (3); *Buteo l. lineatus* (1); *B. p. platypterus* (2). Strigiformes (1): *Strix v. varia* (1). Passeriformes (1): *Hylocichla mustelina* (1).

Known Neotropical Hosts of *L. angustifrons.* Falconiformes (22 and 1 unidentified hawk): *Accipiter b. bicolor* (2); *A. striatus velox* (1); *Busarellus n. nigricollis* (1); *Buteo m. magnirostris* (1); *Cathartes a. aura* (1); *Elanus l. leucurus* (1); *Falco s. sparverius*

[46] No such name could be traced among the owls. Possibly an error for *Buteo magnirostris.*

(1); *Hypomorphnus u. urubitinga* (2); *H. urubitinga ridgwayi* (1); *Ictinia plumbea* (2); *Leucopternis albicollis costaricensis* (1); *Micrastur r. ruficollis* (4); *M. semitorquatus naso* (1); *Milvago c. chimachima* (2); *Odontriorchis palliatus* (1). Psittaciformes (1): *Amazona aestiva xanthopteryx* (1). Strigiformes (3 and 1 unidentified owl): *Ciccaba virgata centralis* (1); *Glaucidium b. brasilianum* (1); *G. brasilianum ridgwayi* (1). Trogoniformes (1): *Trogon* sp. (1). Coraciiformes (1): *Baryphthengus r. ruficapillus; Momotus momota coeruliceps* (1). Piciformes (5): *Pteroglossus a. aracari* (1); *Ramphastos dicolorus* (1); *R. s. sulfuratus* (1); *R. sulfuratus brevicarinatus* (1); *R. swainsonii* (1); *Veniliornis affinis ruficeps*. Passeriformes (3): *Cyanocorax caeruleus* (2); *Pitylus fuliginosus; Pyroderus s. scutatus* (1).

Bionomics. Little is known of the life-history of *L. angustifrons,* even the information on the host relations being unsatisfactory. The Falconiformes, with 8 of the 10 Nearctic and 23 of the 37 Neotropical verified records, are unquestionably the most important and, possibly with owls, the only regular breeding hosts. At present, however, the toucans (Rhamphastidae in Piciformes, with 5 records) cannot be completely ruled out as such, considering how difficult it is to obtain flies from these birds. The few records from parrots, trogons, motmots and passerines are almost certainly based on stray occurrences.

Part I gives information on infestation with mites (p. 157) and on host relations (p. 320). A triple infestation of one *Hypomorphnus urubitinga* by *L. angustifrons* and 2 other species of hippoboscids is discussed under *L. wolcotti.* The puparium is unknown.

Affinities. In the account of *L. wolcotti* I consider at some length the remarkable similarity in structure of that species and *L. angustifrons,* both of which occur in the same general area and on similar birds of prey. Apart from size, they differ very little. On the venter, between the 7th abdominal spiracle and the ano-genital openings, the ♀ of *angustifrons* lacks the raised, soft, bristly knob of *wolcotti,* the corresponding area, bearing only 1 to 3 long setae, not being appreciably raised. The femora and tibiae of both species are amply provided with conspicuous, stiff bristles; but they bear relatively few, scattered, shorter soft setae.

The available material is not adequate for a study of intra-specific variation. The venation appears to vary less than in some congeners. The subcosta is almost always incomplete, such being the case in both wings for 19 (14 ♀ and 5 ♂) of 20 flies from a variety of hosts over a wide territory. In only one ♀ from Laguna Ocotal,

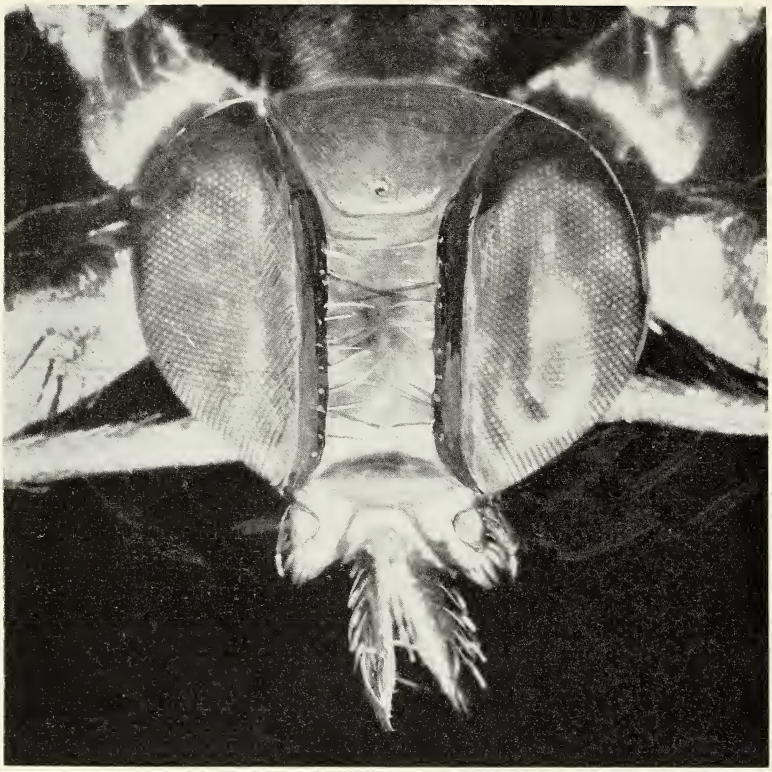

Fig. 58. *Lynchia angustifrons* (van der Wulp), head, ♀, Madison, Wisc., on *Accipiter striatus velox*. Photograph by Mr. K. MacArthur, (1948, fig. 247).

Mexico, on *Hypomorphnus urubitinga ridgwayi*, is the vein incomplete in one wing and complete in the other; another ♀ taken on the same bird has it incomplete in both wings. As usual when the subcosta is incomplete, the vein stops in the membrane at various points, nearly opposite the anterior cross-vein, more basad (Fig. 57*B*), or farther apicad. In both this species and *L. wolcotti*, the postaxillary cell is relatively wider than in most small species of the genus and provided with a distinct longitudinal crease simulating a supernumerary vein.

As a rule the postvertex has a small median pit, not far from the anterior margin, with which the pit is usually connected by a slight roughened depression. Sometimes the bottom of the pit shows a very rudimentary ocellus.

In both sexes, the dorsum of the abdomen has one small, smooth

median sclerite in the striated area, a short distance behind the fused basal laterotergites; this sclerite is somewhat larger and particularly wider (transversely) in the ♂ than in the ♀. Otherwise there is very little difference between the sexes, the relative width of the interocular face being about the same in both.

The setigerous lobe or flap at each side of the genital atrium of the ♂ is similar in size and shape to that of *L. albipennis*.

Original description of *O. angustifrons:* "♂ ♀. Dark brown or blackish, with the legs obscure reddish and the wings brownish-hyaline; 1st vein ending before small cross-vein; 3rd vein reaching costa at ¾ its length; auxiliary vein [subcosta] incomplete. Length 4 mm. More obscurely colored than the preceding [*O. coriacea*], and with the auxiliary vein [subcosta] (which accompanies the 1st vein for about ½ its length) not reaching to costa; the front [interocular face] is scarcely as broad as the eyes and has a narrow glossy space at the sides [inner orbits] and a glossy plate behind [postvertex] which is notched in the middle; the proboscis is longer. The coniform processes on the shoulders [humeral callosities] and the transverse [mesonotal] suture on the thorax are distinct, but the other impressions of the latter are less conspicuous. The legs are rufous, the hind femora elongated. The 1st vein ends distinctly before the small [anterior] cross-vein, which stands nearly at the middle of the wing's length; the 2nd basal cell is much shorter than the superior [1st] one and retracted to near the base of the wing." The two cotypes, seen at the Brit.Mus. in 1951, have the subcosta incomplete in both wings, as noted in the original description. According to Dr. G.B. Fairchild (*in litt.*, Nov. 1953), the wing is 5.4 mm. long in the ♂ and 5.6 mm. in the ♀.

Lynchia wolcotti (Swenk)

Figs. 59*A–D* and 60*A*

Olfersia wolcotti Swenk, 1916, Jl. New York Ent. Soc., **24**, p. 132 (no sex. Michigan: Ann Arbor, on *Buteo p. platypterus.* Type ♀ at Dept. Entom., Univ. Nebraska, Lincoln). Muma, 1952, Bull. Univ. Nebraska State Mus., **3**, pt. 3, p. 14 (type).

Lynchia wolcotti Peters, 1936, Bird-Banding, **7**, p. 13 (Michigan: on *Accipiter striatus velox*). J. Bequaert, 1945, Psyche, **52**, pp. 89 and 101. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, pp. 412 and 419 (Michigan: Swenk's and Peters' records).

Distribution and Specimens Examined. United States. Michigan (recorded by Swenk, 1916; Peters, 1936; MacArthur, 1948): ♀ without precise locality; Ann Arbor, Washtenaw Co., on *Buteo p. platypterus* (♀ holotype.—R.H. Wolcott); McMillan, Luce Co., 2 ♀ on *Accipiter striatus velox*, May 6 (O.M. Bryens; specimens recorded without precise locality by Peters, 1936, and MacArthur, 1948). — Nebraska: Lincoln, Lancaster Co., ♀ on *Buteo p. platypterus* (C.E. Mickel). — New Hampshire: Sandwich, Carroll Co., April 28, ♀ on *Buteo p. platypterus* (R.G. Carpenter).

Mexico: Unión Juarez, 1300 m., State Chiapas, ♀ (P. Brodkorb); Laguna Ocotal, State Chiapas, 2 ♀ on *Micrastur semitorquatus naso* and 1 ♂ on *Hypomorphnus urubitinga ridgwayi* (R.A. Paynter,

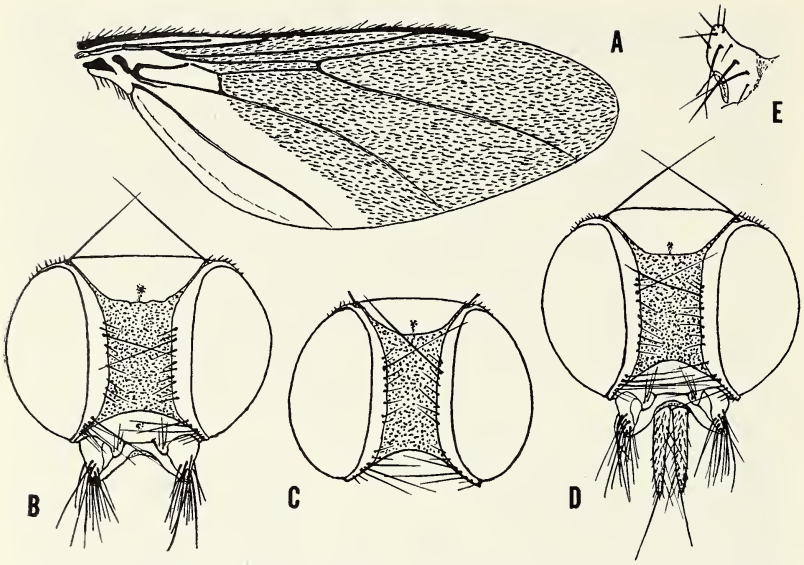

Fig. 59. *Lynchia wolcotti* (Swenk). **A, B** and **E,** ♂, Turrialba, Costa Rica, on owl; **C,** ♀, Nova Teutonia, Brazil, on *Micrastur r. ruficollis;* **D,** ♀, El Volcán, Panama, on hawk: **A,** wing; **B, C** and **D,** head; **E,** humeral callosity.

Jr.) ; Cerro del Sumidero, Tuxtla Gutiérrez, 1300 m., State Chiapas, 2 ♀ on *Otus g. guatemalae* (M. Alvarez del Toro).

Costa Rica: Turrialba, ♂ on owl, possibly *Lophostrix cristata stricklandi* (K.W. Cooper).

Panama: El Volcán, 4100 ft., Chiriqui Prov., R.P., 6 ♀ on hawk (C.S. Worth) : Horquete, 5400 ft., Boquete Prov., R.P., ♀ on *Ciccaba virgata centralis;* Almirante, Bocas del Toro Prov., R.P., ♀ on *Leucopternis albicollis costaricensis* (J.B. Smith).

Venezuela: Rancho Grande, State Aragua, ♀ on *Urubitornis s. solitaria* (W. Beebe) ; Arabupu, Mt. Roraima, State Bolivar, ♀ on *Glaucidium brasilianum phaloenoides* (T.D. Carter).

Brazil: Nova Teutonia near Itá, State Santa Catharina, 27° 11′ S., 2 ♀ on *Micrastur r. ruficollis* (F. Plaumann).

Argentina: Tucumán City, Tucumán, ♀ on *Asio flammeus suinda,* Sept. 15 (O. Budin) ; Cerro de San Javier, Tucumán, ♀ on *Micrastur gilvicollis,* Oct. 20 (O. Budin).

L. wolcotti is one of the rarer American Hippoboscidae. The 26 known specimens are from 16 localities spread from the Great Lakes to northern Argentina and southeastern Brazil. The northmost locality is in Michigan (46° 20′ N.) and the southmost in Brazil

(27° 11′ S.). It probably occurs sporadically over most of the New World.

Known Hosts of *L. wolcotti* (verified individual records in parentheses). Falconiformes (10 and 1 unnamed hawk): *Accipiter striatus velox* (1); *Buteo p. platypterus* (3); *Hypomorphnus urubitinga ridgwayi* (1); *Leucopternis albicollis costaricensis* (1); *Micrastur gilvicollis* (1); *M. r. ruficollis* (1); *M. semitorquatus naso* (1); *Urubitornis s. solitaria* (1). Strigiformes (4 and 1 unnamed owl): *Asio flammeus suinda* (1); *Ciccaba virgata centralis* (1); *Glaucidium brasilianum phaloenoides* (1); *Otus g. guatemalae* (1).

Bionomics. The host records show that the breeding hosts of *L. wolcotti* are only birds of prey. But whether it prefers diurnal or nocturnal Raptores is as yet uncertain, though there are more records from the former. The puparium is unknown. Dr. R.A. Paynter observed 2 cases of multiple infestation at Laguna Ocotal, Mexico: one *Hypomorphnus u. ridgwayi* carried 1 ♂ of *L. wolcotti*, 1 ♀ and 1 ♂ of *Lynchia angustifrons* and 1 ♀ of *Ornithoctona erythrocephala;* while one *Micrastur s. naso* harbored 2 ♀ of *Ornithoctona erythrocephala* and 2 ♀ of *L. wolcotti.*

Affinities. At one time (1933*b*, p. 78) I regarded *L. wolcotti* as based on *L. americana* with abnormally narrow interocular face. I now consider them distinct, though very closely related species. They seem to differ consistently only in the interocular face, which is much narrower in *wolcotti* (proportion of length to width at its narrowest, about 4.5 : 2.5 in *wolcotti*, 4.5 : 3 in *americana*). Some other differences may prove unreliable when more specimens are studied and are, moreover, difficult to appreciate. In *wolcotti*, the inner orbits are relatively narrow, usually $\frac{1}{3}$ of the width of the mediovertex; the palpi are somewhat longer than in *americana*, being only slightly shorter than the mediovertex (Fig. 59*D*); and the humeral callosities appear more acute and more slender (Fig. 59*E*). Each side of the postvertex usually has one vertical bristle; but there are 2 bristles on each side in a ♀ from McMillan, Mich., the other ♀ taken with it having only one. The subcosta is incomplete in both wings in the few specimens seen.

L. wolcotti resembles *L. angustifrons* very closely, the proportions of the interocular face being about the same in both; but *L. wolcotti* is always much larger (wing 8 mm., combined head and thorax about 4 mm. long in *wolcotti;* wing 5 to 6 mm., combined head and thorax about 3 mm. long in *angustifrons*). The width of the interocular face varies somewhat in *wolcotti*, as shown in Figs.

59*B–D;* but I saw no specimens actually transitional to *L. americana.* The close relationship of *L. americana, L. wolcotti* and *L. angustifrons* is puzzling from an evolutionary point of view, as they occur in the same territory on similar or even identical hosts. All three have been taken on the same host species and subspecies (*Accipiter striatus velox*). Both *wolcotti* and *angustifrons* are recorded from *Hypomorphnus urubitinga, Buteo platypterus, Glaucidium brasilianum* and *Ciccaba virgata;* while *wolcotti* and *americana* are both known from *Buteo platypterus, Glaucidium brasilianum* and *Ciccaba virgata.* Possibly all 3 species are comparatively recent offshoots from a common ancestral stock.

Original description of *O. wolcotti:* "Of the same size and general appearance as *O. americana* Leach, above redescribed, but the front [interocular face] much narrower, not wider than the breadth of an eye, the orbital margins subparallel or but slightly narrowing anteriad; clypeus [frons] only about one-half as long as the front [interocular face], the apical section somewhat narrower basally but its apical emargination distinctly deeper and less broad, so that the visible width along the dividing sulcation is nearly one-half of the distance between the lateral apices; palpi blackish, twice as long as the clypeus [frons]; general coloration of head and thorax darker, dark reddish brown rather than yellowish brown as in *americana,* the legs strongly suffused with blackish; wings faintly dusky, the costal veins and basal part of the longitudinal veins blackish." I studied the female holotype at the University of Nebraska in 1940 and again in 1953.

Lynchia nigra (Perty)

Figs. 60*B–G,* 61 and 62

Hippobosca nigra Perty, 1833, Delectus Anim. Artic. Brasil., pt. **3,** p. 190; Pl. 37, fig. 15 (no sex; no host. Brazil: State of Piauhy. Type ♀ in State Zoological Museum of Bavaria, Munich). Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 978 (claims it was found on horse in Brazil, being misled by Perty's use of the generic name *Hippobosca*).

Pseudolfersia nigra Austen, 1903, Ann. Mag. Nat. Hist., (7), 12, p. 266 (no records).

Olfersia nigra Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5,** p. 356 (new description of type); 1908, Zeitschr. Wiss. Insektenbiol., **4,** p. 304.

Lynchia nigra J. Bequaert, 1933, Psyche, **40,** pp. 70 and 79; 1933, Proc. California Ac. Sci., (4), **21,** p. 134. Spencer, 1938, Proc. Ent. Soc. British Columbia, No. **34,** p. 44 (British Columbia: Huntingdon, on *Falco s. sparverius*). Thompson, 1938, Ent. Mo. Mag., **74,** p. 46. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14,** pt. 4, p. 322; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3,** No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16,** No. 11, pp. 280 and 281; 1942, Bol. Entom. Venezolana, **1,** p. 82; 1945, Psyche, **52,** pp. 89 and 101. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8,** pt. 4, pp. 411 and 420, figs. 248 and 249 (Wisconsin: Milwaukee Co., on *Accipiter striatus velox*).

Olfersia fuscipennis Macquart, 1835, Hist. Nat. Ins. Dipt., **2,** p. 640 (no sex; no host. Brazil. Type probably lost; not now at Paris Mus.). Speiser,

1907, Ent. News, **18**, p. 104. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 189 (copy of original description).

Olfersia mexicana Macquart, 1843, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1842), p. 435 (no sex; no host. Mexico. Type ♀ at Paris Mus., from Vera Cruz) [1843, Dipt. Exot., **2**, pt. 3, p. 278]. Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll.., No. **270**, p. 213. van der Wulp, 1903, Biol. Centr.-Amer., Diptera, **2**, p. 430.[47]

Ornithomyia intertropica Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1144 (no sex; no host. Galapagos. Type at Brit. Mus.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 189 (copy of description).

Olfersia intertropica Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 264 (type and 3 other specimens collected by Charles Darwin in the Galapagos. Hawaiian Is.: ♂ ♀ on "owl," Honolulu. Mexico: ♀ Orizaba. Brazil: ♀ Bahia). Aldrich, 1905, Smithson. Misc. Coll., **41**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Austen, 1911, Bull. Ent. Res., **2**, pt. 2, p. 172, footnote (suggests that *Olfersia acarta* Speiser is a synonym). Bau, 1929, Zoolog. Anzeiger, **85**, p. 10 (Queensland: Cooktown).

Lynchia intertropica Ferris, 1930, Canad. Entom., **72**, p. 69, figs. 5*B, C, H* (Arizona: Tucson, on "western red-tailed hawk" [*Buteo jamaicensis calurus*]).

Olfersia pallidilabris Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 161 (no sex; no host. Mexico. Described from 2 cotypes, now probably lost). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst., Osw. Cruz, **7**, p. 191 (copy of description).

Lynchia pallidilabris J. Bequaert, 1945, Psyche, **52**, p. 104.

Lynchia palidilabris Knowlton, Harmston and Stains, 1939, Utah Agric. Expt. Sta., Mimeogr. Ser., **200**, pt. 5, p. 19 (Utah: Richfield, on *Buteo jamaicensis calurus*. Specimen seen my be).

Olfersia obliquinervis Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 162 (no sex; no host. Mexico. Described from 2 cotypes, now probably lost). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 191 (copy of description).

? *Ornithomyia villadae* Dugès, 1887, La Naturaleza, Mexico, (2), **1**, pt. 1, p. 20; Pl. 3, figs. 3*a–h* (no sex. Mexico: on *Buteo jamaicensis calurus* and *Buteo swainsoni* ["*Buteo bairdii*"]. Types presumably lost. Name misspelled "*Ornitomyia villadae*" on p. 18).

? *Olfersia villadae* van der Wulp, 1903, Biol. Centr.-Amer., Diptera, **2**, p. 430. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104 (doubts the generic reference).

? *Lynchia villadae* J. Bequaert, 1945, Psyche, **52**, p. 103.

Olfersia acarta Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 149 (no sex. Hawaiian Ids.: Molokai, holotype, without host; Lanai, without host; Kona, Hawaii, on "short-eared owl" [probably *Asio flammeus sandwichensis*]. Holotype from Molokai at Bremen Mus.; paratypes from Kona at Brit.Mus., listed as the largest of the three Hawaiian Hippoboscidae by Grimshaw, 1901, Fauna Hawaiiensis, **3**, pt. 1, p. 77; present location of Lanai paratype unknown); 1902, Fauna Hawaiiensis, **3**, pt. 2, p. 87 (host of Molokai fly here given by error as "*Atagen aquila*," a man-of-war bird). Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p.

[47] *Pseudolfersia mexicana* of Speiser (1902), Aldrich (1905), and Speiser (1907) was not Macquart's species, but *Olfersia bisulcata* Macquart.

264 (paratypes from Kona). Alfken, 1904, Zool. Jahrb., Abt. Syst., **19**, p. 572. Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303. Bryan, 1934, Proc. Hawaiian Ent. Soc., **8**, pt. 3, pp. 443 and 458.

Olfersia dukei Austen, 1911, Bull. Ent. Res., **2**, pt. 2, p. 171 (♀. Uganda: Nsadzi I., in Lake Victoria, on *Haliaeëtus v. vocifer*. Type at Brit.Mus.).

Lynchia dukei J. Bequaert, 1933, Psyche, **40**, pp. 70 and 80; 1945, *Op. cit.*, **52**, pp. 89 and 102.

Ornithomyia nigricans Johnson, 1898, Proc. Ac. Nat. Sci. Philadelphia, p. 164 (Abyssinia: Dada on Daroli River; 2 specimens seen by me at Ac.N.S.Phila.). Not of Leach, 1817.

Olfersia raptatorum Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 181; Pl. 28, fig. 3 (no sex. Brazil: without more precise locality, on *Caracara plancus brasiliensis* [*"Polyborus tharus"*], *Milvago c. chimachima, Leucopternis polionota* [*"L. palliata"*], and other diurnal birds of prey; also taken in the State of Piauhy on *Cathartes aura ruficollis*. Cotypes at the Instituto Osw. Cruz in Rio de Janeiro). Ad.Lutz and Nuñes-Továr, 1928, Estudios Zoología Parasitología Venezolanas, p. 9 (Venezuela: without precise locality, on diurnal birds of prey). Bau, 1930, Konowia, **9**, pt. 3, p. 209 (Bolivia: Las Taperas, on *Herpetotheres cachinnans queribundus;* Río Grande, near Sa. Cruz de la Sierra, on *Buteo* [*"Asturina"*] *nitidus pallidus*). Carbonell, 1938, Parasitología en Venezuela y los Trabajos del Dr. M. Nuñez-Továr, p. 251.

Lynchia raptatorum J. Bequaert, 1933, Psyche, **40**, p. 82. Martorell, 1939, Jl. Agric. Univ. Puerto Rico, **23**, p. 221. J. Bequaert, 1945, Psyche, **52**, p. 103.

Ornithoponus americanus Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (Galapagos: Seymour Bay, Indefatigable I., on *Buteo galapagoensis*). Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366 (Galapagos: Santa Cruz, Indefatigable I.). Not of Leach, 1817.

Lynchia fusca Knowlton, Harmston and Stains, 1939, Utah Agric. Expt. Sta., Mimeogr. Ser., **200**, pt. 5, p. 19 (Utah: Park Valley. Specimen seen by me).

Lynchia sp. Travassos and Teixeira de Freitos, 1941, Mem. Inst. Osw. Cruz, **35**, (for 1940), pt. 3, p. 537 (Brazil: Salobra, State of Matto Grosso, on *Gampsonyx s. swainsonii*. Specimen seen by me).

The earlier *Hippobosca nigra* Osbeck, 1757, is pre-Linnean, hence without standing in nomenclature. It was later cited by v. Olfers (1816), but without a description, so that it remained a *nomen nudum*. It does not invalidate Perty's *Hippobosca nigra*.

Several published references to *"nigra* Perty," not included in the foregoing bibliography, were based on misidentifications. Thus Walker's (1849) *O. nigra* was *Olfersia spinifera*. Lutz, Neiva and da Costa Lima's (1915) *O. nigra*, from owls in Brazil, was *L. americana* Leach, while their *Olfersia raptatorum* was the true *L. nigra* Perty. Austen's (1903) *Pseudolfersia nigra* appears to have been *Olfersia spinifera*. Johnson's (1924) supposed *O. intertropicus*, from the Galapagos, was *Lynchia albipennis*.

Distribution and Specimens Examined. Dominion of Canada. Alberta: McMurray, 56° 40′ N. (J.A. Loring).—British Columbia (recorded by Spencer, 1938): Osayoos, Bridesville, Summit, Yale-Cariboo Co., 49° 2′ N., on *Buteo jamaicensis borealis* (L.M. Laing); Huntingdon, New Westminster Co., 49° N., on *Falco s. sparverius* (G.J. Spencer); Grindrod, Yale-Cariboo Co., 50° 37′ N., on *Buteo jamaicensis borealis* (J. Wynne); Merritt, Yale-Cariboo Co.,

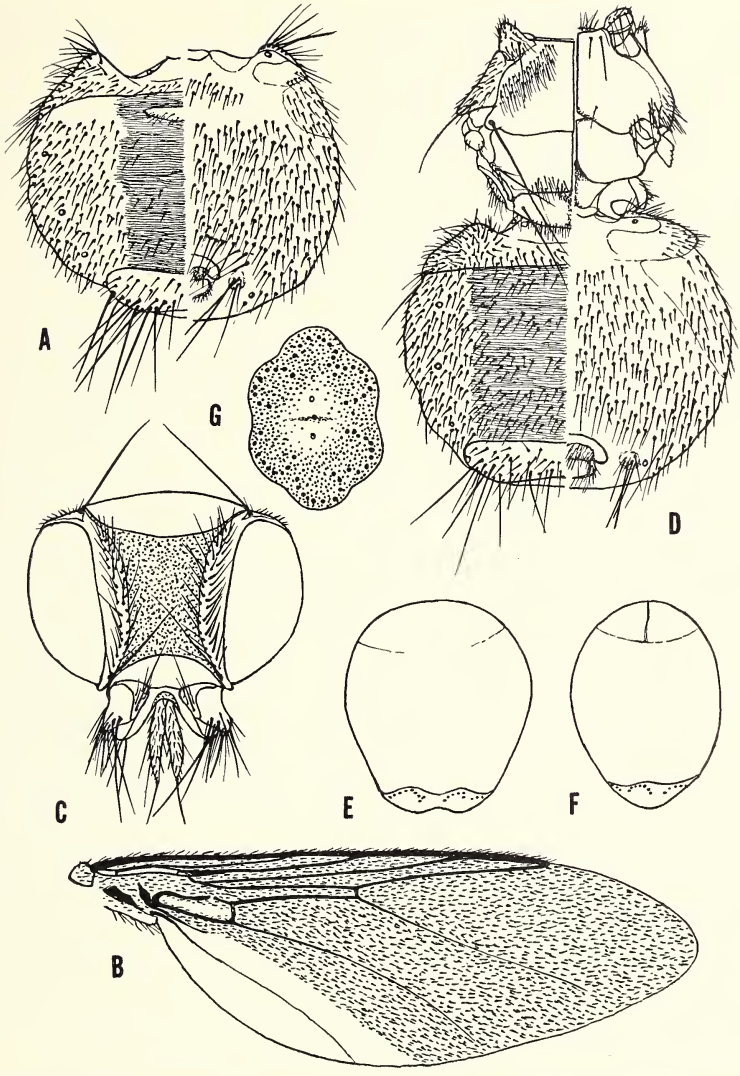

Fig. 60. **A**, *Lynchia wolcotti* (Swenk), abdomen dorsally and ventrally, ♀, Arabupu, Venezuela, on *Glaucidium brasilianum phaloenoides*. **B–G**, *Lynchia nigra* (Perty): **B–D**, ♀, Subirana, Honduras: **B**, wing; **C**, head; **D**, thorax and abdomen dorsally and ventrally; **E–G**, puparium, West Point, N.Y., from fly on *Buteo jamaicensis borealis*, from above (**E**), in side view (**F**) and respiratory lobes (**G**).

50° 6′ N., on *Buteo jamaicensis borealis* (J.A. Munro). — Quebec: Kamouraska (au Moulin), Kamouraska Co., 47° 35′ N., on *Falco peregrinus anatum* (W. LaBrie).

United States. Arizona (recorded by Ferris, 1930): Tucson, Pima Co., on *Buteo nitidus plagiatus,* Apr. 5 (A.R. Phillips), and on *Buteo jamaicensis calurus* (the latter recorded by Ferris, 1930, as *L. intertropica*); Huachuca Mts., Cochise Co. (H.S. Swarth); Sells, Pima Co., on *Buteo swainsoni* (C.T. Vorhies); E. of Tucson, Pima Co., on *Cathartes a. aura* (A.R. Phillips); 3 miles N. of Arivaca Junction, Pima Co., on *Bubo virginianus pallescens,* Dec. 4 (R.W. Dickerman and A.B. Phillips). — Colorado: Denver, on *Buteo jamaicensis calurus,* March 29 (W.H. Bergtold). — Idaho: Joe's Gap, Preuss Range, 5 miles N.E. of Montpelier, Bear Lake Co., on *Buteo jamaicensis calurus* (Edna Brodkorb). — Kansas: Lawrence, Douglas Co., on *Falco s. sparverius,* Apr. 11 (Bunker); Franklin Co., on owl (W. Clanton). — Minnesota: without precise locality, on *Falco s. sparverius* (N.B. Nelson). — Montana: Beaver Head Co. (H.B. Mills); Truman Siding, Ravalli Co., on *Buteo jamaicensis calurus,* May 11 (N. Krams and R.T. Kawk). — New Mexico: without more precise locality and host; 10 miles N. of Beaverhead Ranger Station Railroad, Catron Co., on *Aquila chrysaëtos canadensis* (H.C. Pickens and E.M. Long). — New York: West Point, Orange Co., on *Buteo jamaicensis borealis,* Apr. 30 (W. Robinson). — Texas: Fort Davis, Jeff Davis Co., Apr. 12, on *Falco s. sparverius* and (probably) *Cathartes aura septentrionalis* (J. Van Tyne); Elkart, Anderson Co., on hawk, Apr. 29 (W.S. Crusen); El Paso, 3700 ft., El Paso Co. (H.A. Scullen). — Utah: 5 miles N. of Moab, Grand Co. (Rowe); Park Valley, Box Elder Co., May 22 (R.C. Roskelley); Richfield, Sevier Co., on *Buteo jamaicensis calurus* (Lee Kay). — Washington (State): Twisp, Okanogan Co., on sparrow hawk (Stanford U. Mus.). — Wisconsin (recorded by MacArthur, 1948): Milwaukee Co., on *Accipiter striatus velox,* Oct. 5 (P.W. Hoffmann). — Wyoming: without precise locality, on *Circus cyaneus hudsonius.*

Mexico (recorded by Dugès, 1887, types of his doubtful *O. villadae;* Austen, 1903): Xocempich, 10 miles from Chichen Itzá, Yucatan (D.B. Legters); between Pisté and Yotzonot, Yucatan, on *Herpetotheres cachinnans chapmani,* Nov. 5 (D.B. Legters); Chichen Itzá, Yucatan, on *Geranospiza n. nigra, Buteo magnirostris conspectus,* and *Buteo nitidus plagiatus* (J. Van Tyne); Tabi, Quintana Roo, on *Ictinia plumbea,* June 23 (D.B. Legters); El Sumidero, Tuxtla Gutiérrez, State Chiapas, 400 m., on *Herpetotheres cachinnans chapmani,* Jan. 22 (M. Alvarez del Toro); Divisadero, Tuxtla

Gutiérrez, State Chiapas, 525 m., on *Buteo nitidus plagiatus*, Aug. 3 (M. Alvarez del Toro); Loma Larga, Tuxtla Gutiérrez, State Chiapas, 525 m., on *Buteo nitidus plagiatus*, Sept. 17, and *Buteo jamaicensis costaricensis*, Jan. 15 (M. Alvarez del Toro); Los Frailes Bay, Baja California, on *Caracara cheriway audubonii*, Feb. 16 (G. Augustson); San Carlos Bay, State Sonora, on *Buteo jamaicensis calurus*, Feb. 8 (G. Augustson); Pedegral, Munic. Tancitaro, 6000 ft., State Michoacan, on *Buteo jamaicensis calurus* (H. Hoogstraal and R. Traub); Apatzingan, State Michoacan, on young hawk (R. Traub); La Puerta de Hambre, Munic. Apatzingan, 1200 ft., State Michoacan, on *Falco mexicanus* (R. Traub); Sierra de Nayarit, State Jalisco, Apr. 30, on chicken hawk; Xochitepec, State Morelos, on *Buteo* sp. (Esc.N.C.Biol.); Aguililla, State Morelos (Esc. N.C. Biol.); Mexico City (R. Muller); Payal, State Chiapas (H. Wagner); Orizaba, State of Vera Cruz; 14 miles S. of El Arco Mine, Vizcaina Desert, N. of San Ignacio, Baja California, on hawk (? *Buteo jamaicensis calurus*) (E.S. Ross); El Gavilán, Ocozocoautla, State Chiapas, on *Buteogallus a. anthracinus* (M. Alvarez del Toro).

Republic of Honduras: Zamorano, 20 miles from Tegucigalpa, on *Buteo nitidus micrus* (S.K. Harris); Subirana, Yoro (R. Stadelmann).

Panama: Pacora, Panama Prov., R.P., on *Buteogallus a. anthracinus* (L.H. Dunn).

Venezuela (recorded by Lutz and Nuñes-Továr, 1928, as *O. raptatorum*): San Felipe, on *Herpetotheres c. cachinnans* (P. Anduze); between Caracas and El Sombrero, State Miranda (E.G. Holt); Cantaura, State Anzoategui, on *Falco c. columbarius* (F.D. Smith); Caicara, State Monagas, on *Daptrius ater* (F.D. Smith).

British Guiana: Upper Rupununi River (J. Ogilvie).

Brazil (recorded by Perty, 1833; Austen, 1903; Lutz, Neiva and da Costa Lima, 1915, as *O. raptatorum*): Bahia; Maracajú, State Matto Grosso, on *Cathartes a. aura* and "gavião" or "fulvous-bellied kite" (R.M. Gilmore); Rio São Francisco, State Bahia, on hawk, No. 1004 (J.A. Allen, Thayer Exped.); Nova Teutonia near Itá, State Santa Catharina, on owl (F. Plaumann); Salobra, State Matto Grosso, on *Gampsonyx s. swainsonii* (Inst.Osw.Cruz); Bodoquena, State Matto Grosso; Parnaguá, State Piauhy, on *Caracara plancus brasiliensis* and *Cathartes aura ruficollis* (cotypes of *O. raptatorum*. —A. Neiva); State Goyaz, on *Piaya cayana pallescens* (A. Neiva); State Matto Grosso, on *Herpetotheres cachinnans queribundus* (Stanislau); Botucatú, State São Paulo on "gavião" (Werner); Rio das Mortes, Chavantina, State Matto Grosso, on *Falco sparverius*

eidos, Herpetotheres cachinnans queribundus and *Milvago c. chimachima* (H. Sick); State Piauhy, ♀ holotype of *H. nigra* (now labeled only "Brasilien"); Fazenda Recreio, Coxim, State Matto Grosso, on *Accipiter bicolor pileatus* and *Heterospizias m. meridionalis* (J. Lima).

Galapagos (recorded by Walker, 1849, as *O. intertropica;* Austen, 1903; Johnson, 1924; Curran, 1942): without precise locality (type of *O. intertropica* Walker); Seymour Bay, Indefatigable I., on *Buteo galapagoensis* (W. Beebe); Academy Bay, Indefatigable I., on *Buteo galapagoensis* (J.P. Chapin); head of Tagus Cove, Albemarle I. (Crane Pacific Exp.); James I. (E. Cheesman).

Bolivia (recorded by Bau, 1930, as *O. raptatorum*): Buena Vista, Prov. Sara, on a diurnal bird of prey (J. Steinbach).

Argentina: Las Palmas, Chaco, on *Buteo magnirostris superciliaris* (A. Wetmore).

L. nigra is essentially a tropical fly in both the Old and the New World. In the United States and Canada its occurrence is sporadic, probably following occasional introduction of adult flies by migrant birds from farther south. The northmost record from 56° 40′ N., in Alberta, is clearly accidental, all other Canadian captures being from south of 51° N. The southmost record, from the Argentinian Chaco (north of 28° S.), is well within the subtropical zone. It has not been taken thus far in the Antilles. In the Old World the distribution, although imperfectly known, appears to be strictly tropical. In Africa, where it has been called thus far *L. dukei,* it is known from the Ivory Coast, the Island of S. Thomé, Cameroon, French Congo, Belgian Congo, Ruanda, Uganda, Ethiopia, Kenya and Tanganyika Territory. There is one published record from Queensland (Bau, 1929). It has also been taken in Hawaii (J. Bequaert, 1941*b,* p. 281), on the endemic Hawaiian race of *Asio flammeus.*

Known Nearctic Hosts of *L. nigra* (verified individual records in parentheses). Falconiformes (20 and 3 unidentified hawks): *Accipiter striatus velox* (1); *Aquila chrysaëtos canadensis* (1); *Buteo jamaicensis borealis* (4); *B. jamaicensis calurus* (5); *Buteo nitidus plagiatus* (1); *B. swainsoni* (1); *Cathartes a. aura* (1); *Circus cyaneus hudsonius* (1); *Falco peregrinus anatum* (1); *F. s. sparverius* (4). Strigiformes (1 and 1 unidentified owl): *Bubo virginianus pallescens* (1).

Known Neotropical Hosts of *L. nigra.* Falconiformes (32 and 8 unidentified hawks): *Accipiter bicolor pileatus* (1); *Buteo galapagoensis* (2); *B. jamaicensis calurus* (2); *B. jamaicensis costaricensis*

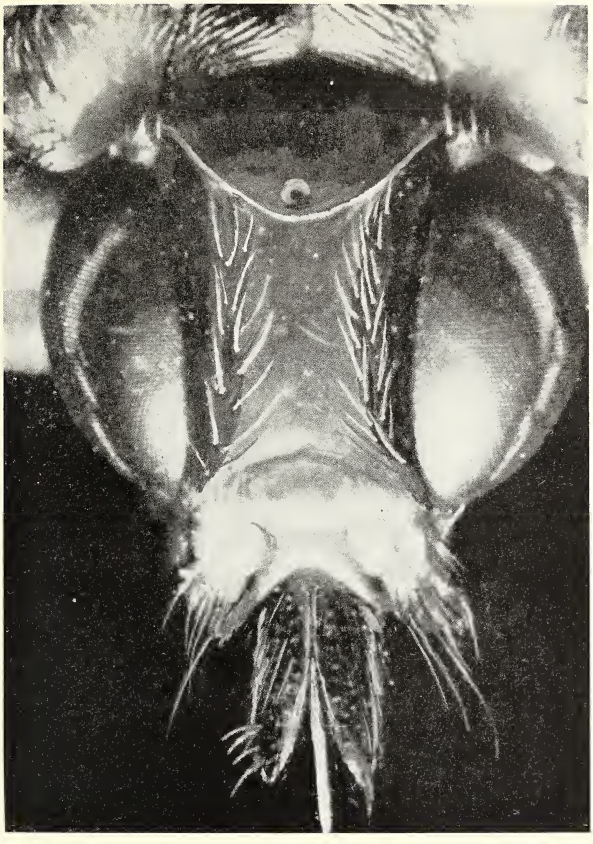

Fig. 61. *Lynchia nigra* (Perty), head, ♂, Milwaukee Co., Wisc., on *Accipiter striatus velox*. Photograph by Mr. K. MacArthur, (1948, fig. 248).

(1); *B. magnirostris conspectus* (1); *B. magnirostris superciliaris* (1); *B. nitidus micrus* (1); *B. nitidus pallidus; B. nitidus plagiatus* (3); *B. swainsoni; Buteogallus a. anthracinus* (2); *Caracara cheriway audubonii* (1); *C. plancus brasiliensis* (1); *Cathartes a. aura* (1); *C. aura ruficollis* (1); *Daptrius ater* (1); *Falco c. columbarius* (1); *F. mexicanus* (1); *F. sparverius eidos* (1); *Gampsonyx s. swainsonii* (1); *Geranospiza n. nigra* (1); *Herpetotheres c. cachinnans* (1); *H. cachinnans chapmani* (2); *H. cachinnans queribundus* (2); *Heterospizus m. meridionalis* (1); *Ictinia plumbea* (1); *Leucopternis polionota; Milvago c. chimachima* (1). Cuculiformes (1): *Piaya cayana pallescens* (1).

In the Old World the many African records of *L. nigra* (= *dukei*) are all from 10 Falconiformes: *Aquila r. rapax*, *Buteo rufofuscus augur*, *Circaëtus cinereus*, *Gymnogenys t. typicus*, *Gypohierax angolensis*, *Haliaeëtus v. vocifer* (a particularly favored host), *Hieraaëtus ayresii*, *Milvus migrans parasitus*, *Terathopius ecaudatus*, and *Urotriorchis macrourus batesi*. Specimens were taken in Hawaii on an owl, *Asio flammeus sandwichensis*.

Bionomics. The foregoing lists of hosts and verified records show conclusively that *L. nigra* is one of the most characteristic parasites of diurnal birds of prey, which are its only normal breeding hosts in the New World as well as in Africa. It seems to occur only as an accidental stray on the American vultures (Cathartidae); otherwise it shows little selectivity within the order Falconiformes. The very few American captures on a cuckoo (*Piaya*) and on owls were due either to straggling or to contaminations. It is more difficult to account for the several flies taken on four occasions from owls in the Hawaiian Islands. One of these flies dates from 1878 and the collectors noted that it was "frequent on owls." It might be interesting to investigate whether or not *L. nigra* occurs also on the native Hawaiian hawk, *Buteo solitarius*, on which no bird-fly has been taken thus far. Possibly the flies found on the local owls have strayed from this hawk.

Very little is known of the life-history of *L. nigra*. In Part I (p. 157) I mentioned 5 cases of parasitism by mites, to which the following may now be added:

6. Female on *Buteo galapagoensis*, from Academy Bay, Indefatigable I., Galapagos, with one female mite surrounded by a few eggs and fixed to the under side of the anterior cross-vein, about mid-length of the left wing.

7. Female on *Buteo jamaicensis calurus*, from Truman Siding, Montana, with large mite clusters on the under side near the base of both wings, 3 on the right and 4 on the left side.

The following account of the puparium of *L. nigra* (Figs. 60*E–G*) is based on a specimen deposited as larva by a fly from *Buteo jamaicensis borealis* at West Point, N.Y., April 30. It is not fully colored, being dull reddish mahogany-brown, except for the black cap at the posterior end, but appears otherwise normal. It is very broadly oval, slightly narrowed posteriorly, somewhat more convex dorsally, 4.2 mm. long, 3.2 mm. wide and 2.5 mm. thick. It differs little from that of *L. americana*, but the respiratory pores are fewer in each of the 6 curved groups.

Affinities. *L. nigra* occupies an isolated position in the genus.

In addition to the characters selected for the key, it differs from its congeners as follows. The palpi are moderately long, much less than half, although over one-third of the height of the head (from occipital margin to tips of frontal arms), and broader in profile in proportion to the length than in *L. americana.* The 1st antennal segment is separated from the lunula by a deep, complete suture. The lower (ventral) edge of the antennal pits, on either side of the buccal cavity (filled with the basement membrane), is very prominent, almost tuberculate, densely bristly. The hind corner of the notopleuron (fused with the prescutum), bearing the notopleural bristle, is strongly raised, tuberculate. The humeral callosities are broader than usual, nearly as wide as their distance from the median notal suture. In the wing, the 2nd basal cell is much shorter than half the length of the 1st and broader than in *L. americana.* The body is more hirsute than usual, the setae being more numerous on the occipital surface of the head, the humeral callosities, the anepisternum, the postalar corners of the mesoscutum, the preäpical row and apical fringe of the scutellum, the metathoracic pleurotergite, and the antennae (particularly the 1st segment). Some areas are also covered with grayish-white pollinosity due to matted, dense microscopic hairs (as noted by Ferris, 1930*c*, pp. 69–70, for *L. intertropica*, a synonym of *L. nigra*), particularly on the upper orbits, antero-lateral corners of prescutum (near the short posthumeral suture), anepisternum (both dorsally and ventrally), metathorax, and a narrow strip close to the scuto-scutellar suture; the abdomen also is often dull grayish pollinose, especially on the large preänal tergite.

The subcosta is normally complete and ending in the costa in *L. nigra*, this being the case in 38 of 39 American, in all 3 Hawaiian, and in all 20 African specimens examined. It is, however, incomplete in both wings in one of a series of 6 flies taken on a hawk in Nayarit, Mexico. The 1st longitudinal ends in the costa opposite the anterior cross-vein or slightly basad (Fig. 60*B;* and Ferris, 1930*c*, p. 68, fig. 5*B*).

L. nigra is the largest species of the genus, the wing being usually 7.5 to 8.5 mm. long, seldom 9 mm. or even slightly more. A dwarf ♀ from Piauhy, Brazil, with wings only 7 mm. long, agrees in every other respect with the larger flies.

The African *L. dukei*, thus far generally treated as distinct, is here regarded as not separable from the American *L. nigra.* In the original description, copied below, Austen mentioned its close affinity to *Olfersia intertropica* Walker (a synonym of *L. nigra*), but

Fig. 62. *Lynchia nigra* (Perty), terminalia of ♂, Milwaukee Co., Wisc., on *Accipiter striatus velox*. Photograph by Mr. K. MacArthur (1948, fig. 249).

pointed out some differences. Of these, the more elongate and darker palpi, as well as the sparser and coarser pilosity and sculpture of the inner orbits, soon proved unreliable, when more African material was studied. In my two revisions of the larger *Lynchia* (1933*b*; 1945*b*), I retained as distinguishing feature only the shape of the postvertex, contrasting this as follows:

Postvertex long, semi-elliptical, the anterior angles broadly rounded, the anterior margin convexly curved and about as long as the sides ..... *L. nigra*

Postvertex short, more transverse, the anterior angles more abruptly rounded off, the anterior margin much longer than the sides ..... *L. dukei*

A comparison of many African and American specimens has shown that this supposed difference is untenable. The shape of the postvertex varies so much that identical specimens can be found on both sides of the Atlantic. Indeed, in one female from *Buteo jamaicensis calurus*, of Montana, the postvertex is more transverse, shorter and broader than in any African so-called "*dukei*."

In the male terminalia (Fig. 62), the gonocoxites are larger, more prominently lobate and with heavier bristles in *L. nigra* than in *L. americana*. In both species the abdomen of the ♀ bears ventrally on each side near the apex a setigerous knob not present in the ♂.

Original description of *H. nigra:* "Nigro-fusca; polita, alis subfuliginosis Lg. $2\frac{2}{3}$ lines [German lines = about 5.8 mm.]. Latit. alar. expans. 8 lines [spread of wings = 17.5 mm.]. *H. equina* Fabr. paullo minor. Tota nigro-fusca, nitida. Frons glabra, lateribus et postice aeneo-micans. Thorax in-aequalis. Abdomen subopacum. Alae subfuliginosae, costa fusca. Subtus cum pedibus paullo dilutior." This description furnishes practically no clue as to the identity of the species and the figure shows only that it was one of the larger American species of *Lynchia.* My study of Perty's type has shown that it is the species described later by Walker as *Ornithomyia intertropica,* by Speiser as *Olfersia acarta,* and by Lutz, Neiva and da Costa Lima as *Olfersia raptatorum.* This type, now at the State Zoological Museum in Munich, is a ♀ with many orbital bristles, placed in more than one row. Speiser (1905), who recognized that it was a *Lynchia* (= *Olfersia* of Speiser, not of Wiedemann), made the following notes (translated from the German): "Length of dry specimen, 5.75 mm.; from apex of frons to hind margin of scutellum, 3.75 mm. Head medium-sized as compared with thorax, with evenly rounded, not sinuate occiput. Postvertex distinctly and rather deeply sinuate anteriorly. Interocular face ['Stirnstrieme'] slightly narrowed anteriorly [toward frons], though fully $\frac{2}{3}$ the width of an eye, even close to frons. Orbits with fine, blond setae. Clypeus [frons] divided by a transverse furrow, the posterior section with a distinct groove, almost as in *Olfersia* ['*Pseudolfersia*' of Speiser], the anterior section split by a flattened emargination into two short points. Antennal appendages short, with black setae. Maxillary palpi almost straight. Thorax of the usual shape and sculpture; humeral callosities and sides of scutellum not paler than remainder of surface; hind margin of scutellum slightly rounded-convex, not truncate. Legs dark brownish-black; under side of femora somewhat paler. Wings brownish; anal [axillary] cell hyaline. Abdomen entirely dried up. The general color, which seems to have been almost black or at least dark pitch-brown when Perty's drawing was made, now looks bleached, pale pitch-brown, the head even somewhat paler."

Original description of *O. fuscipennis* (translated from the French): "Length, $2\frac{1}{2}$ [French] lines [= 5.6 mm.]. Pitch-black, somewhat shiny. Palpi rather large, little lengthened, provided with setae. Frons with two small pits; one larger, beyond the suture; the other small, nearer the anterior border. Sides of the buccal cavity protuberant and fringed with long setae; a small spot of white down [pollinosity] at the base of the antennae. Abdomen with a gray down [pollinosity]. Legs brownish-black. Wings blackish; inner side, from the base to near mid-length, pale yellowish." Although Macquart stated that the specimen came from the Paris Museum, it is not to be found there now and is presumably lost. The measurements point to the large South American species of *Lynchia, L. nigra.* Some of the characters mentioned in the description fit *L. nigra* so well that I do not hesitate to relegate *O. fuscipennis* to the synonymy of that species. The pitch-black color, the large but moderately long palpi, the protuberant sides of the buccal cavity (immediately below the antennal pits), the pollinose spot at the base of the antenna, the grayish pollinose abdomen, and the blackish wings are particularly to be noted.

Original description of *O. mexicana* (French text translated): "Nigra. Thorace linea dorsali testacea. Alis nigricantibus. Long. $2\frac{3}{4}$ [French] lines [= 6 mm.]. Black. Proboscis elongate, yellow. Face brownish, with a cross-line and two pits. Frons [interocular face] with the sides [inner orbits] and occipital spot [postvertex] shiny coppery-green; frontal band [mediovertex] blackish, almost dull. Under side of head testaceous. Thorax with greenish sheen; a testaceous dorsal line; humeri brownish, with a row of small spicules; sternum fulvous. Abdomen brown. Legs black above, greenish-fulvous below. Wings blackish; inner side, from the base to near the middle, pale yellow." The description was based on a specimen at the Paris Museum, evidently one of the larger American species of *Lynchia.* There are now at Paris two flies under "*Olfersia mexicana.*" One of these is a female from "Mexico: Vera

Cruz,'' which I regard as Macquart's type, since it agrees perfectly with the description. It cannot be separated from *L. nigra* (Perty). The second fly is much larger and otherwise also disagrees with the description; it is a female of *Ornithoctona erythrocephala* (Leach). In the Bigot Collection, now the property of Mr. J.E. Collin, there is a third fly labelled ''*Olfersia mexicana,*'' apparently by Macquart himself. This again does not agree with the original description and was identified by me as *Olfersia bisulcata* Macquart. Some time before, Mr. J.E. Collin also reached the conclusion that it was cospecific with the type of *O. bisulcata,* with which he compared it. Moreover, it was examined by Speiser (1904), who placed it correctly in his genus *Pseudolfersia,* now considered a synonym of *Olfersia.* Whichever of the three specimens is taken as the original type, the specific name *mexicana* will be relegated to the synonymy.

Original description of *O. intertropica:* ''Picea, ferrugineo varia, verticis margine albido, pedibus fulvis, alis fuscis. Body pitchy, smooth, shining, thinly clothed with short tawny hairs: crown of the head ferruginous, with whitish borders, mouth and appendages tawny: chest ferruginous on each side and behind and adorned with a ferruginous stripe: abdomen dull, its tip beset with a few stout black bristles: legs dark, tawny, clothed with short black hairs and bristles; claws black; wings brown; wing-ribs and fore border veins pitchy; the other veins dark tawny. Length of the body 3 lines [=6.35 mm.]; of the wings 8 lines [=spread of wings, 17.13 mm.].'' Austen (1903) examined the type and concluded that it was a species of *Lynchia* [''*Olfersia*'' of Austen, not of Wiedemann]. I have also seen this type at the British Museum and it agrees in every way with what I call *L. nigra.*

Original description of *O. pallidilabris:* ''Long. mill. 6–7. Corpus nigrum; labio sordide albicante; fronte nec foveolata nec punctis impressis signata, orbitis angustis et areola verticis pumicatis, ista antice rotundata non in medio incisa. Proboscis nigricans in linguam filiformem non elongata. Palpi nigricantes, proboscide paulo longiores, et ad latera eam tegentes, non erecti. Thorax in dorso, cum scutello nitidissimus. Abdomen opacum, pilosulum, apici plus minusve luride albicans. Alae infuscatae, fuscedine postice versus basim dilutiore: venis nigris: secunda longitudinale, parum sed paulo ante transversam exteriorem costalem attingente: tertia, in costa magis distante a quarta quam a secunda: transversa exteriore non obliqua, et paulo ante apicem sita primae longitudinalis. Pedes nigricantes, partim sordide glauci, praesertim antici, ut femora omnia subtus et basi.'' The types could not be located in 1951 at the Genoa Museum nor in Bellardi's collection now in Turin, and Dr. B. Lanza (*in litt.,* 1953) informs me that they are not in Rondani's collection now in Florence. They are most probably lost. Like *O. obliquinervis* (discussed below), it was evidently one of the larger species of *Lynchia,* either *L. americana* or *L. nigra.* Rondani seems to have separated his *O. obliquinervis* and *O. pallidilabris* mainly by the presence or absence of ''foveae'' on the frons, as well as by the relative position of the tip of the 1st longitudinal vein (which he calls the ''second,'' as he considers the subcosta to be the ''first'') and anterior cross-vein (which he calls the ''outer cross-vein''). Of *pallidilabris* he says that the ''frons'' is neither foveolate nor provided with punctiform depressions; and of *obliquinervis* that the ''frons'' bears an upper impressed dot and a smaller one lower down near the mouth. From the context it is clear that he referred to the depressions on the lunula, which are often but not always present in both *L. americana* and *L. nigra,* so that they are unreliable as a specific character. The tip of the 1st longitudinal is said to be placed in *pallidilabris* ''not much but a little ('parum sed paulo') before [basad of] the anterior cross-vein,'' and in *obliquinervis* ''distinctly beyond [apicad of] the anterior cross-vein.'' As Speiser (1902) noted for his *O. acarta,* a synonym of *L. nigra* (see below), the position of the tip of the 1st longitudinal varies in *L. nigra:* it is usually nearly opposite the anterior cross-vein, but it may be also somewhat before or beyond, though never very far. In *L.*

americana, on the other hand, the 1st longitudinal always ends much before (basad of) the anterior cross-vein. For this reason it seems fairly certain that both of Rondani's names were based on specimens of *Lynchia nigra,* a common Mexican fly. Some other features mentioned by Rondani fit *L. nigra* better than *L. americana,* notably the dull whitish bloom (pollinosity) over the hind part of the abdomen. It may be of interest that the late J.M. Aldrich used the trivial name *pallidilabris* for specimens of *L. nigra* at the U.S. National Museum.

Original description of *O. obliquinervis:* "Long. mill. 6–7. Nigro-picea: Frons puncto impresso supero, et minore infero prope os, signata: Verticis areola latiuscula, subtrigona et orbitis angustis nitidissimis. Palpi et proboscis breves, nigricantes. Abdomen nigro-opacum, apice plus minusve sordide albido. Alae infuscatae, angulo interiori axillari fuscedine dilutiore. Pedes nigricantes, femoribus basi, et paulo etiam inferne luride glaucis, etc. Notae istae *O. fuscipennis* Macq. et aliis congeneribus etiam conveniunt, sed in nostra characteres adsunt magni momenti in diagnosibus auctorum non indicati, specificam differentiam comprobantes; ut sequitur. Sp. nostrae alae ad radicem tuberculum distinctum, elevatum, nitidum praebent: venulam transversam interiorem valde obliquam, sub-integram, et interius longe ab apice longitudinalis primae sitam: secundam longitudinalem costali conjunctam distincte ultra transversam exteriorem, et in costa magis proximam tertiae quam primae: tertiam magis proximam quartae quam secundae. Praeterea *fuscipennis* brasiliana, et *obliquinervis* mexicana." As in the case of *O. pallidilabris,* the types of *O. obliquinervis* could not be traced and should be regarded as lost. This species also was evidently either *Lynchia americana* or *L. nigra,* most probably the latter. As shown before, the characters used by Rondani to separate *O. obliquinervis* from *O. pallidilabris* are not reliable and the descriptions of both forms agree better with *L. nigra* than with *L. americana.*

Original description of *O. villadae* (translated from the Spanish): "Shiny blackish-brown; head with a metallic green glitter, changing to coppery with the light; margins of frons [inner orbits], median line of thorax [median notal suture] and scutellum dull reddish; fore legs dark brown, the other four blackish; wings smoky and eyes black. The proboscis, curved downward, is slender at the tip and globose at the base, being inserted on a tubercle shaped as drawn; this organ seems to me to be simple, forming a tube which surrounds a sharp stiletto capable of being protruded from a subterminal opening of the tube. The antennae, very setose on their outer surface, consist of two segments, one large, concave anteriorly, the other small, inserted in the concavity of the first. The spoon-shaped palpi cover the base of the proboscis. The first four segments of the tarsi are short and equal; the fifth is longer, hollow beneath, and this space is covered with a membrane, an arrangement which no doubt helps the retraction and hiding of the claws; these are tridentate and have a pad between them; several long bristles arise from the upper as well as the under part of the fifth tarsal segment." It is also stated that there are no ocelli. No measurements are given, but fig. 3*a,* said to be natural size, is 13 mm. long from anterior margin of frons to tip of folded wings. Fig. 3*b* shows a typical *Lynchia* head, with the interocular face broader than one eye and narrowed anteriorly, and the palpi much longer than the frons. These features, combined with the fact that it was collected three times and on two species of *Buteo,* make it most probable that *O. villadae* was based on *Lynchia nigra,* the common large *Lynchia* on diurnal birds of prey in Mexico.

Original description of *O. acarta* (translated from the German): "Length, 6.25 mm.; from apex of frons to hind margin of scutellum, 4 mm. Main color dark shiny blackish-brown; humeral callosities and head, particularly mouthparts, paler, even leather-yellow; basal half of femora of the same color, the legs as a whole somewhat paler. Head slightly over half the greatest width of thorax; occiput evenly rounded, without emargination or inward curve. Vertex [interocular face] a little over $\frac{1}{3}$ of width of head, slightly narrowed

downward over upper $\frac{2}{3}$, then wider again, being at the antennal pits once more as wide as at postvertex, dull medially [mediovertex]; inner orbits and postvertex shiny, the latter with undivided anterior margin. Inner margin of inner orbits with many blond setulae, similar to those of *O. exornata* Speiser and some other species, but not as nicely parted as in *exornata;* I regard this pilosity as the one important difference from *O. pallidilabris* Rondani, the description of which stresses 'orbitis angustis et areola verticis pumicatis,' but mentions no pilosity. Frons ['Clypeus oris'] divided into two successive areas, more distinctly in this species than in others; dull leather-yellow (in Rondani's species 'sordide albicans'), anteriorly with a slight angular emargination, but without projecting edges or points; without foveae, unless one should regard as such the slight lateral depressions of the transverse furrow. Antennal appendages fairly long and wide, intensely shiny black, with black bristles. Maxillary palpi, forming the sheath for the proboscis, pitch-brown, projecting slightly beyond frons ['Clypeus'], relatively wide and blunt. Thorax somewhat wider than long, dark shiny blackish-brown, with a very fine yellow longitudinal line [median notal suture], dull leather-yellow humeral callosities, and a small spot of the same color on each lateral angle of scutellum. Posterolateral angles of prescutum, at dorsopleural and transverse sutures, covered with light spots of dull-gray bloom, present also on pleura before the wings except for a raised streak extending anteriorly and downward from base of wing. Very fine longitudinal suture of thorax continuing over scutellum and much widened there, but narrowing again toward hind margin of scutellum. Transverse [mesonotal] suture not interrupted medially, but instead very fine and linear over $\frac{1}{2}$ to $\frac{3}{4}$ mm. where it crosses the longitudinal furrow, while it is deeply grooved laterally. Scutellum broadly semi-circular, with a transverse furrow before hind margin and with a longitudinal depression, which is at first broad, then narrowed posteriorly into a ridge; the very characteristic yellow spots on the lateral angles were mentioned before; close to these a strong bristle placed on each side more toward the middle in the dark brown area; hind margin densely provided with fine, blond setulae. Similar setulae also on disk of thorax, such setulae not being mentioned for *O. pallidilabris* Rondani. Pleura and humeral callosities with black, short setae, as usual. Fine suture between humeral callosities and prescutum with longer, fine setulae, similar to those of *O. exornata* Speiser, but shorter. Finally two small rounded spots before scutellum covered with very short, golden-yellow setulae. Legs without striking peculiarities. Fore femora rather thick; hind legs somewhat longer than usual. Nothing is to be said about sculpture, setulae or special color pattern; but the wings show interesting features. They are light hazel-brown, not clouded nor milky. Costa interesting, being swollen beyond tip of 1st longitudinal vein ['Subcostalis'] to almost twice basal thickness, as described by Rondani for *O. papuana* and by me for a recent new species, *O. parallelifrons;* 1st longitudinal vein ['Subcosta'] ending basad of anterior cross-vein ['kleine Querader']; 2nd longitudinal vein ['Radialis'] much closer to tip of 1st longitudinal ['Subcosta'] than to that of 3rd longitudinal ['Cubitalis'], exactly as Rondani described for his *O. pallidilabris,* although he did not mention the swollen costa; last section of costa therefore twice as long as penultimate; 4th longitudinal vein ['Discoidalis'] not raised into a knob at its starting point; 2nd basal cell ['hintere Basalzelle'] at its widest not as wide as distance from elbow of 4th longitudinal ['Discoidalis'] to anterior margin, somewhat less than half as long as 1st basal cell ['vordere Basalzelle'] and closed by a distinct cross-vein. Abdomen dull dirty-brown, without peculiarities, somewhat paler and almost yellowish-brown apically.'' The foregoing description was that of the holotype from Molokai. The following notes were based on additional paratypes: ''Head sometimes somewhat more brightly colored; in particular, inner orbits may be almost as pale yellow as frons ['Clypeus oris']. In one specimen, anterior margin of postvertex slightly depressed medially. Position of tip of 1st longitudinal vein variable in this species also:

in several specimens placed directly above anterior cross-vein ['kleine Querader'] and in one even a trifle beyond it in one wing. Finally it should be noted that in most of these paratypes the tip of the abdomen has a whitish bloom, which recalls the 'abdomen . . . apici plus minusve luride albicans' of *O. pallidilabris* Rondani.'' The paratypes I have seen from Kona are *L. nigra;* but I have not seen the holotype from Molokai. There can be little doubt, however, that it belonged to the same species, the numerous setulae of the inner orbits being particularly characteristic.

Original description of *O. dukei:* ''♀. Length 7 mm.; width of head 2 mm.; width of front [interocular face] at vertex 1.4 mm.; length of wing 9.4 mm. [According to Dr. G.B. Fairchild, Nov. 1953, length of wing 9.1 mm.]. General coloration black or clove-brown; sides of front (frontal margins or parafrontalia [inner orbits]), plate on vertex [postvertex], and dorsum of thorax (except humeral calli) shining black or blackish clove-brown; abdomen, dorsal surfaces of middle and hind legs, and dorsal surface of front femora clove-brown; anterior $\frac{2}{3}$ of inner borders of sides of front [inner orbits] clothed with fairly long yellowish hair, with as usual a single longer black hair in front and behind [orbital bristles]; wings sepia-colored. Head: shining plate on vertex [postvertex] transversely elongate, anterior angles rounded off, length [=width] of hind margin [occipital margin] at least $2\frac{1}{2}$ times as great as depth [=length] of plate from front to rear; frontal stripe [mediovertex] (in dried specimen) clove-brown; face raw-umber-colored in centre, dark brown on each side below; jowls and under surface of head on each side mummy-brown, central area of under surface of head ochraceous buff; under surface of head clothed with bright, ochre-yellow hair; palpi relatively rather narrow (from above downwards) and elongate, their outer surfaces dark brown or clove-brown, and clothed with brownish hair; visible portion of antennae shining dark brown, clothed with black hair. Thorax: humeral calli raw-umber-colored, dark brown behind, clothed above with black mixed with ochre-yellow hairs; portion of dorsum immediately behind humeral calli, and in front of transverse suture, clothed with appressed, ochre-yellow hairs; hind margin of scutellum and portion of thorax immediately in front of scutellum also clothed with ochre-yellow hairs; pleurae blackish and clothed with similarly-colored hair; pectus raw-umber-colored. Abdomen clothed for most part with black hair. Wings: principal veins and thicker portions of veins clove-brown or dark brown. Legs: front tibiae and tarsi, and under surface of front femora (in dried specimen at any rate) more or less raw-umber-colored; under surfaces of middle and hind femora and tibiae (in dried specimen) more or less mummy-brown; legs clothed for most part with black or blackish hair; claws black. Although closely allied to and resembling *Olfersia* (*Ornithomyia*) *intertropica* Walk., the species described above is distinguishable by its more elongate and darker palpi, by the hairs and punctures on the inner borders of the sides of the front [orbital bristles] being fewer in number and coarser, and especially by the different shape of the shining plate on the vertex [postvertex], which is more transversely elongate, and the anterior angles of which are more abruptly rounded off.'' The type was examined at the British Museum in 1933 and again in 1951. I have given before my reasons for now considering *O. dukei* and *L. nigra* cospecific. In the holotype of *O. dukei* the subcosta is complete in both wings.

Original description of *O. raptatorum* (translated from the Portuguese): ''Palpi and antennae yellow, bristles partly dark; frons [interocular face] chocolate color, but anterior and posterior triangles [postvertex and frons] and the lateral margins [inner orbits] ochraceous-gray, with a greenish metallic gloss; small grooves at tips of both triangles; ventral side of head ochraceous. Mesonotum chocolate color, with a greenish gloss and golden hairs; humeral callosities ochraceous-gray, with a whitish spiracular spot at outer base. Median notal suture reddish, continued over hind half of scutellum; the latter rounded, with a depressed submarginal line, and both with bright white termi-

nal ciliae. Transverse mesonotal sutures deep and sinuate, united at median suture. Upper side of abdomen and legs chocolate color, under side paler, mixed with ochraceous. Wings with the characters mentioned [in the key, p. 181, where they are said to have a bare area extending outside the axillary cell]; alula small; veins chestnut, 4th vein followed by a very distinct fold; another fold runs from tip of costa toward tip of 4th vein and forms a dark streak in the anterior half of its course. Length of body 6½ mm.; of head and thorax combined 4 mm.; of wing 7½ to 8 mm.'' Through the courtesy of Dr. L.R. Guimarães I was able to examine several cotypes of *L. raptatorum*, and recognized that they belong to *L. nigra* (Perty).

Lynchia albipennis (Say)

Figs. 5*A*, 63*A–H*, 64 and 65

Olfersia albipennis Say, 1823, Jl. Ac. Nat. Sci. Philadelphia, **3**, p. 101 (no sex. United States: without precise locality, on *Ardea h. herodias.* Type lost); 1837, Oeuvres Entomologiques (ed. by Gory), p. 102; 1859, Complete Writings, (ed. by Le Conte), **2**, p. 87. Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Brodie and White, 1883, Check List Ins. Dom. Canada, p. 57. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 340. Johnson, 1913, Bull. Amer. Mus. Nat. Hist., **32**, p. 90 (Florida: St. Augustine, on *Ardea herodias occidentalis;* Biscayne Bay). Swenk, 1916, Jl. New York Ent. Soc., **24**, pp. 126 and 133 (Nebraska: Lincoln, on *Nycticorax nycticorax hoactli* [as *N. n. ''naevius''*] and *Butorides v. virescens;* the latter fly, made ''neotype,'' at Dept. Entom., Univ. Neb.). Johnson, 1922, Psyche, **29**, p. 82 (Massachusetts: Allston, on *Nycticorax nycticorax hoactli,* New Jersey: records of 1900, 1910, as *O. ardeae.* Florida: records of 1913. [Hampston, N.H., record erroneous, based on *L. angustifrons,* as corrected by Johnson, 1925]). Wolcott, 1924, Jl. Dept. Agric. Porto Rico, **7**, (for 1923), pt. 1, p. 234 (Puerto Rico: Río Piedras). Johnson, 1925, Occ. Papers Boston Soc. Nat. Hist., **7**, p. 294 (Massachusetts: 1922 record). Zebrowski, 1932, Audubon Yearbook, Indiana Audubon Soc., p. 48. Wolcott, 1936, Jl. Agric. Univ. Puerto Rico, **20**, pt. 1, p. 392. Muma, 1952, Bull. Univ. Nebraska State Mus., **3**, pt. 3, p. 14 (the ''neotype'' selected by Swenk, 1916).

Lynchia albipennis Bequaert, 1933, Proc. California Ac. Sci., (4), **21**, No. 11, p. 134. Peters, 1936, Bird-Banding, **7**, p. 11 (Ohio: on *Nycticorax nycticorax hoactli*). Herman, 1937, *Op. cit.*, **8**, p. 164 (Massachusetts: North Eastham, on *Nycticorax nycticorax hoactli*). Thompson, 1938, Ent. Mo. Mag., **74**, p. 46. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 322 and 323; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, No. 11, pp. 280 and 282. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 1, p. 121. J. Bequaert, 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 82; 1943, Jl. of Parasitology, **29**, p. 135. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, pp. 410 and 422, figs. 250–251 (Wisconsin: Fox River, Tichigan Marsh, Racine Co., on *Butorides v. virescens.* Illinois: Chicago, on *Botaurus lentiginosus;* McHenry, on *Botaurus lentiginosus;* Horseshoe Lake, on *Ardea h. herodias;* Decatur; Urbana; River Forest. Minnesota: Bald Eagle Lake, on *Botaurus lentiginosus.* Michigan: Manchester, on *Ixobrychus e. exilis;* Bass Lake, Livingston Co., on *Gallinula chloropus cachinnans;* Patterson Lake, Livingston Co., on *Botaurus lentiginosus.* Tennessee: Nashville, on *Gallinula chloropus cachinnans*). Thompson, 1949, Ent.

Mo. Mag., **85**, p. 248 (Jamaica: Rio Cobre Irrigation Canal, Grove Place, St. Catherine, on *Ardea h. herodias;* Bowden, St. Thomas, on *Nyctanassa v. violacea*). Wolcott, 1951, Jl. Agric. Univ. Puerto Rico, **32**, (for 1948), pt. 3, p. 531.

[? *Hippobosca metallica* Schummel, 1832, Uebersicht Arb. Veränd. Schlesisch. Ges. Vaterl. Cultur, p. 71 (Silesia: on *Botaurus stellaris.* Without description). *Nomen nudum*].

Olfersia ardeae Macquart, 1835, Hist. Nat. Ins. Dipt., **2**, p. 640; Pl. 24, fig. 10 (no sex. Sicily: on a heron. Type probably lost). Schiner, 1864, Fauna Austriaca, Die Fliegen (Diptera), **2**, p. 645. Loew, 1864, Amer. Jl. Sci. Arts, (2), **37**, p. 318 (occurrence in North America). Walsh, 1864, Proc. Ent. Soc. Philadelphia, **3**, p. 216. van der Wulp, 1867, Tijdschr. v. Entom., **10**, p. 126 (Wisconsin). Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 213. Rondani, 1879, Bol. Soc. Ent. Italiana, **11**, p. 22 (Italy: on *Ardea purpurea, A. cinerea* and *Botaurus stellaris*). Howard, 1883, South Carolina, Resources and Population, p. 275. Johnson, 1900, 27th Rept. New Jersey Bd. Agric., (for 1899), Suppl., p. 699 (New Jersey: Delaware River, on *Botaurus lentiginosus, Nycticorax nycticorax hoactli,* and *Florida c. caerulea*). Washburn, 1905, Univ. Minnesota, Agric. Expt. Sta., Bull. **93**, p. 163 (Minnesota: on *Botaurus lentiginosus*). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 244, 245, and 304. Johnson, 1910, Ann. Rept. New Jersey State Mus., (for 1909), p. 814 (New Jersey: Bristol I., Delaware Riv.; other records as in 1900). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 189 (copy of original description).

Alfersia ardeae Schiner, 1853, Verh. Zool. Bot. Ver. Wien, **3**, Abhandl., pp. 153–154 (Czechoslovakia: Moravia, on *Botaurus stellaris*).

Ornithoponus ardeae Falcoz, 1926, Faune de France, **14**, Diptères Pupipares, p. 32, figs. 30–31 (France: Ain, on *Botaurus stellaris*).

Lynchia ardeae Peters, 1936, Bird-Banding, **7**, p. 11 (Alabama: on *Florida c. caerulea*). Brimley, 1938, Insects North Carolina, p. 390 (North Carolina: Raleigh, on *Casmerodius albus egretta*).

Olfersia ardaea Em. Blanchard, 1840, Hist. Nat. Insectes, **3**, p. 631 (error for *ardeae* Macquart).

Olfersia ardea Thalhammer, 1900, Fauna Regni Hungariae, **3**, Diptera, p. 69 (error for *ardeae* Macquart).

Lynchia ardea Peters, 1933, Bird-Banding, **4**, p. 70 (Alabama: on *Florida c. caerulea;* error for *ardeae* Macquart).

Olfersia propinqua Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1141 (no sex; no host. Jamaica. Type ♀ at Brit. Mus.) Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Johnson, 1894, Proc. Ac. Nat. Sci. Philadelphia, p. 281. Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (type. Refers to it van der Wulp's paratype of *Olfersia coriacea* from Presidio, Mexico). Aldrich, 1905, Smithson. Misc. Coll., **44**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull., **4**, pts. 1–2, p. 90.

Lynchia propinqua J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, p. 323.

Olfersia botauri Rondani, 1879, Bol. Soc. Ent. Italiana, **11**, p. 22 (no sex. Central Italy: on *Ardea purpurea.* Type at Natural History Museum in Florence, labelled as from Liguria).

Olfersia coriacea van der Wulp, 1903, Biol. Centr.-Amer., Diptera, **2**, p. 430 (in part: paratype of the species, from Mexico: Presidio).

Olfersia palustris Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 183; Pl. 28, fig. 4 (no sex. Brazil: Piauhy, on *Casmerodius albus egretta* [*"Herodias egretta"*], *Tigrisoma lineatum marmoratum* [*"Tigri-*

soma brasiliense''], *Cochlearius c. cochlearius* [*''Cancroma cochlearia''*] and *Mesembrinibis cayennensis* [*''Harpiprion cayennensis''*]; Rio São Francisco, on *Casmerodius albus egretta* [*''garça branca''*]; Lassance, Est. Minas Gerais, on *Ardea cocoi* [*''Ardea socoi''*]. Types at Inst. Osw. Cruz, Rio de Janeiro). Ad. Lutz and Nuñes-Továr, 1928, Estudios Zoología Parasitología Venezolanas, p. 9 (Venezuela: on several herons). Carbonell, 1938, Parasitología en Venezuela y los Trabajos del Dr. M. Nuñez-Továr, p. 251. Not of J. Bequaert, 1933*b*, p. 71.

Lynchia palustris Martorell, 1939, Jl. Agric. Univ. Puerto Rico, **23**, p. 221.

Olfersia botaurinorum Swenk, 1916, Jl. New York Ent. Soc., **24**, pp. 128 and 133 (no sex. Nebraska: Omaha, holotype and paratype on *Ixobrychus e. exilis;* Lincoln, paratype on *Botaurus lentiginosus.* Types, all ♀, at Dept. Ent., Univ. Nebraska, Lincoln). Muma, 1952, Bull. Univ. Nebraska State Mus., **3**, pt. 3, p. 14 (holotype only listed).

Lynchia botaurinorum Peters, 1936, Bird-Banding, **7**, p. 11 (New Hampshire: on *Casmerodius albus egretta.* South Carolina: on *Leucophoyx t. thula.* Ohio: on *Botaurus lentiginosus*). Thompson, 1936, Ann. Mag. Nat. Hist., (10), **18**, p. 309 (Mexico: Orizaba, with 5 Mallophaga, *Ardeicola botauri,* attached).

Lynchia botaweirorum Strickland, 1938, Canad. Jl. Res., Sect. D, **16**, p. 219 (Alberta: on *Botaurus lentiginosus*). Error for *L. botaurinorum.*

Olfersia scutellaris Swenk, 1916, Jl. New York Ent. Soc., **24**, pp. 129 and 133 (no sex. Michigan: Watkins' Station near Manchester, on *Ixobrychus e. exilis.* Type ♀ at Dept. Entomology, Univ. Nebraska, Lincoln). Muma, 1952, Bull. Univ. Nebraska State Mus., **3**, pt. 3, p. 14 (type).

Olfersia intertropica Swenk, 1916, Jl. New York Ent. Soc., **24**, pp. 129 and 133 (Mexico: Orizaba; specimen seen in Swenk Coll.). Not of Walker, 1849.

Ornithoponus intertropicus Johnson, 1924, Zoologica, New York, **5**, pt. 8, p. 91 (Galapagos: Seymour Bay, Indefatigable I., on *Butorides sundevalli*). Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366. Not of Walker, 1849.

Lynchia setosa Ferris, 1927, Philippine Jl. Sci., **34**, p. 224, figs. 14 and 15*a–c* (Philippine Islands: Palawan, ♂ holotype on *Bubulcus* [*ibis*] *coromandus;* Lucban, Tayabas Province, Luzon, ♀ allotype on same host. Types in Stanford Univ. Museum, Palo Alto, California); 1930, *Op. cit.,* **43**, p. 552 (Philippines: Manila, ♂ on *Circus* sp.; Obando, Bulacan Prov., Luzon, ♂ on *Ixobrychus* [*sinensis*] *astrologus*).

Lynchia massonati O'Mahony, 1940, Jl. Soc. British Ent., **2**, pt. 2, p. 75 (Ireland: Enniscorthy, Co. Wexford, on *Ixobrychus m. minutus.* I have seen this specimen). Not of Falcoz, 1926.

Distribution and Specimens Examined. Dominion of Canada. Alberta (recorded by Strickland, 1938, as *L. botaurinorum*): Belvedere, Edmonton Co., 54° N., on *Botaurus lentiginosus* (C.G. Harrold). — British Columbia: Wasa, 49° 48′ N., on *Botaurus lentiginosus* (J. Poole). — Manitoba: Birtle, 50° 26′ N., on *Botaurus lentiginosus* (R.D. Bird). — Ontario: Wellington, 43° 58′ N., on *Botaurus lentiginosus* (C.H.D. Clarke); Point Pelée, Essex Co., 41° 54′ N., on *Botaurus lentiginosus* (A.D. Andrews); Toronto, on *Ixobrychus e. exilis* (H. Southam); Dwight, Muskoka Co., 45° 20′ N. (F.P. Ide). — Quebec: Montreal, on *Botaurus lentiginosus* (J. Ouellet); Kamouraska (au Moulin), Kamouraska Co., 47° 35′ N.,

on *Anas crecca carolinensis* (W. La Brie) ; Ile Perrot, 45° 20′ N., on *Botaurus lentiginosus,* Nov. 1 (Fr. Lionel Philippe).

United States. Alabama (recorded by Peters, 1933 and 1936, as *L. ardeae*) : Dauphin I., Mobile Co., on *Florida c. caerulea,* June 9 (H.S. Peters). — Florida (recorded by Johnson, 1913, 1922) : Biscayne Bay, Dade Co. (Mrs. A. Slosson) ; Eau Gallie, Brevard Co., (W.W. Worthington) ; Bowlogs Key, on *Ardea herodias occidentalis,* Feb. 5 (E.G. Holt) ; Levy Co. (P. Laurent) ; St. Augustine, Alachua Co., on *Ardea herodias occidentalis,* Nov. 8 (C.W. Johnson) ; Richmond, 20 miles S. of Miami, Dade Co., on Man (W.W. Wirth) ; Myakka River, Sarasota Co., on *Florida c. caerulea* (L.R. Penner). — Georgia : Brunswick, Glynn Co., on *Hydranassa tricolor ruficollis* (Mrs. R.C. Simpson) ; Griffin, Spalding Co. (C.M. Beckham) ; [Savannah, Chatham Co., on *Casmerodius albus egretta;* Cleveland, White Co. — Recorded by P.W. Fattig, *in litt.;* not seen]. — Illinois (recorded by MacArthur, 1948) : without precise locality (C.W. Johnson) ; N. Dearborn, Chicago, on *Botaurus lentiginosus;* River Forest, Cook Co. (W. Mann) ; Grant Park, Chicago, 1 ♂ 6 ♀ on *Botaurus lentiginosus,* Aug. 3; McHenry, McHenry Co., on *Botaurus lentiginosus* (J. Friesser) ; Decatur, Macon Co., on *Botaurus lentiginosus;* Urbana, Champaign Co. — Indiana : without precise locality (C.W. Johnson). — Iowa : Ames, Story Co., on *Ardea h. herodias,* Apr. 16; Iowa City, Johnson Co. (H.F. Wickham) ; Ruthven, Palo Alto Co., on *Botaurus lentiginosus* (Frances Hamerstrom). — Kansas : without precise locality, on *Nycticorax nycticorax hoactli;* Riley Co. (E.A. Popenoe) ; Douglas Co., on *Porzana carolina* (A. Wetmore), *Ardea h. herodias,* Apr. 15 (T. Rockland), and *Porphyrula martinica* (R.H. Burt). — Louisiana : Cameron, Cameron Co., on *Butorides v. virescens,* Dec. 14 (S.H. Roberts) ; Creole, Cameron Co., on *Botaurus lentiginosus,* Nov. 21 (W.W. Wirth). — Maryland : Bowie, Patuxent Research Refuge, Prince Georges Co., on *Tringa melanoleuca* (R.T. Mitchell) ; Marshall Hall, Charles Co., Aug. 7 (A.N. Caudell). — Massachusetts (recorded by Johnson, 1922; Herman, 1937) : North Eastham, Barnstable Co., on *Nycticorax nycticorax hoactli* (C.M. Herman) ; Springfield, Hampden Co. (G.A. Allen) ; Woods Hole, Barnstable Co., on *Nycticorax nycticorax hoactli,* Aug. 15 (G.A. McCallum) ; Chatham, Barnstable Co., on *Tringa melanoleuca,* Apr. 26 (R.P. Dow) ; Allston, Boston, on *Nycticorax nycticorax hoactli,* Aug. 1 (C.W. Johnson). — Michigan (recorded by Swenk, 1916, as *O. scutellaris;* MacArthur, 1948) : Silver Lake Park, Oceana Co. (A.L. Olson and L.K. Gloyd) ; Patterson Lake, Livingston Co., Sept. 30, on *Botaurus lentiginosus* (J.

Van Tyne) ; Bass Lake, Putnam, Livingston Co., on *Gallinula chloropus cachinnans* (J. Van Tyne) ; Watkins Station near Manchester, Washtenaw Co., on *Ixobrychus e. exilis* (type of *scutellaris* Swenk. — R.H. Wolcott). — MINNESOTA (recorded by Washburn, 1905, as *O. ardeae;* MacArthur, 1948) : Lake Minnetonka, Hennepin Co., June 19 (F.M. Uhler) ; Excelsior, Hennepin Co. (F.M. Uhler) ; Bald Eagle Lake, on *Botaurus lentiginosus* (R.W. Macy) ; Saint Paul, Ramsey Co., on *Botaurus lentiginosus* (S. Kepperley) ; Dr. Ohage's Place, on *Botaurus lentiginosus,* May 9, 1898. — MISSISSIPPI : Handsboro, Harrison Co., on *Butorides v. virescens,* Apr. 24 (G.G. Rohwer) ; Oxford, Lafayette Co. (F.M. Hull). — MISSOURI : St. Louis, on *Butorides v. virescens,* May 12 (R.C. Froeschner) ; Hollister, Taney Co., Apr. (H.H. Knight). — MONTANA : Ravalli Co., on *Botaurus lentiginosus* (L. Humble). — NEBRASKA (recorded by Swenk, 1916, as *O. botaurinorum*) : Lincoln, Lancaster Co., on *Botaurus lentiginosus* (♀ paratype of *botaurinorum.* — J.C. Crawford), *Nycticorax nycticorax hoactli* (L. Bruner), and *Butorides v. virescens* (J.S. Hunter, ♀ selected by Swenk as "neotype" of *albipennis* Say; J.T. Zemmer) ; Omaha, Douglas Co., on *Ixobrychus e. exilis* (♀ holotype and ♀ paratype of *botaurinorum.* — R.H. Wolcott) ; Garden Co, on *Nycticorax nycticorax hoactli* (A.M. Brooking) ; Glenville, Clay Co., on *Botaurus lentiginosus* (A.M. Brooking). — NEW HAMPSHIRE (recorded by Peters, 1936, as *botaurinorum*) : Hinsdale, Cheshire Co., on *Casmerodius albus egretta* (H.S. Peters). — NEW JERSEY (recorded by Johnson, 1900, 1910, as *O. ardeae*) : Bristol I., Delaware River, on *Florida c. caerulea* (Fowler) ; Ramsey, Bergen Co. (L. Hook). — NEW YORK : Ithaca, Tompkins Co., on *Botaurus lentiginosus;* West Point, Orange Co., Apr. 8 (W. Robinson) ; West Nyack, Rockland Co., on *Botaurus lentiginosus,* May 3 ; Orient, Long Island, on *Butorides v. virescens,* June 1, *Florida c. caerulea,* Sept. 3, *Pandion haliaetus carolinensis,* and *Nyctanassa v. violacea* (R. Latham) ; Delmar, Albany Co., on *Nycticorax nycticorax hoactli* (E.J. Gerberg) ; Branchport, Yates Co., on *Botaurus lentiginosus* (V. Burtsch) ; Greenport, Long Island, on *Botaurus lentiginosus,* Sept. 18 (R. Latham) ; Northwest, Long Island, on *Butorides v. virescens,* June 30 (R. Latham) ; Mt. Sinai, Long Island, on *Butorides v. virescens* (R.C. Murphy) — NORTH CAROLINA (recorded by Brimley, 1938, as *L. ardeae*) : Raleigh, Wake Co., Apr. 8 (C.S. Brimley) and on *Casmerodius albus egretta* (H.H. Brody) and *Ixobrychus e. exilis,* Aug. 7 (C.S. Brimley) ; Orton Point (D.L. Wray). — OHIO (recorded by Peters, 1936, as *L. botaurinorum*) : Greenville, Darke Co., on *Butorides v. virescens*

(R. Rausch); Buckeye Lake, Parry Co., on *Nycticorax nycticorax hoactli*, Apr. 26 (H.S. Peters); Wilmington, Clinton Co., on *Mycteria americana* (R.M. Goslin); Toledo, Lucas Co., on *Botaurus lentiginosus* (L.W. Campbell); Columbus, Franklin Co., on *Falco s. sparverius* (A. Stupka); Kirtland, Lake Co., Dec. 7, on *Botaurus lentiginosus* (F.C. Bishopp). — OKLAHOMA: Stillwater, Payne Co. (J.M. Maxwell). — PENNSYLVANIA: West Chester, Chester Co., on *Ardea h. herodias* (R.M. Stabler); Harrisburg, Dauphin Co. (W.R. Walton); Reading, Berks Co., on *Accipiter striatus velox* (L.S. Dillon); Hiner, Clinton Co., on *Botaurus lentiginosus* (G. Link); Sewickley, Allegheny Co., on *Botaurus lentiginosus* (W.E.C. Todd); Pittsburgh, Allegheny Co.; Philadelphia, on *Botaurus lentiginosus* (C.W. Johnson); Philadelphia Neck, on *Botaurus lentiginosus*, Oct. 12, and *Ixobrychus e. exilis* (C.W. Johnson); eastern Pennsylvania, on *Nycticorax nycticorax hoactli* (C. Liebeck). — SOUTH CAROLINA (recorded by Peters, 1936, as *L. botaurinorum*): Central, Pickens Co., on *Botaurus lentiginosus* (D. Dunavan); Clemson College, Oconee Co. (S. Williamson); Santee, Charleston Co., on *Tyto alba pratincola* (R.E. Bishop); Florence, Florence Co., on *Florida c. caerulea;* James I., Charleston Co., on *Butorides v. virescens* (E.R. Kalmbach); Heron I. near Charleston, Charleston Co., on *Leucophoyx t. thula*, July 3 (E.M. Batton and G.R. Lunz). — SOUTH DAKOTA: Brookings, Brookings Co., 4 flies on *Ixobrychus e. exilis*, May 21 (N. Hartwig); 20 miles N. of Watertown, Codington Co., on *Botaurus lentiginosus* (G.B. Spawn). — TENNESSEE (recorded by MacArthur, 1948): Nashville, Davidson Co., on *Gallinula chloropus cachinnans* (Mrs. A.R. Laskey). — TEXAS: Kennedy Co., on *Nyctanassa v. violacea*, Aug. 19; Galveston, Galveston Co., on *Hydranassa tricolor ruficollis*, June 14, and *Dichromanassa r. rufescens*, July 24 (R.W. Strandtmann). — VIRGINIA: Great Falls, Fairfax Co., on *Piranga r. rubra* (A. Wetmore). — WASHINGTON (STATE): Pullman, Whitman Co., Oct. 6 (L.R. Campbell). — WISCONSIN (recorded by van der Wulp, 1867, as *O. ardeae;* MacArthur, 1948): Mink River, Door Co., on *Ixobrychus e. exilis*, June (W.J. Woodman); Fox River, Tichigan Marsh, Racine Co., on *Butorides v. virescens* (K.W. MacArthur); Milwaukee, Milwaukee Co., on *Ixobrychus e. exilis*, May 19 (W. Pelzer); Mahomet, Champaign Co., on *Butorides v. virescens*, May 11 (G. W. Hahn); Racine, Racine Co., 3 ♀ on *Botaurus lentiginosus*, May 7 (E.J. Rokosky). — WYOMING: without precise locality, on *Ixobrychus e. exilis*.

MEXICO (recorded by van der Wulp, 1903, as *O. coriacea;* Swenk, 1916, as *O. intertropica;* Thompson, 1936, as *O. botaurinorum*): San

Gabriel Bay, Baja California, on *Ardea herodias sanctilucae,* Feb. 13 (G. Augustson); Río Usumacinta near Frontera, State Tabasco, on *Mycteria americana* (C.H.T. Townsend); Ebano, State San Luis Potosi, on *Botaurus lentiginosus* (R.J. Newman); Orizaba, State Vera Cruz (A. Sallé, with 5 *Degeeriella botauri* attached, as recorded by Thompson, 1936; L. Bruner, Swenk's supposed *intertropica*); Presidio [not located by State] (van der Wulp's supposed ♂ paratype of *O. coriacea*).

Republic of Honduras: Puerto Castilla, on *Ardea herodias occidentalis* (R.H. Painter).

Panama: Ancon, C.Z., on Man (A.H. Jennings); Cristobal, C.Z.; Puerto de Chorrera, Panama Prov., R.P., on *Cochlearius cochlearius panamensis* (W.W Middlekauff).

Antilles. Bahamas: Nurse Cay, Ragged I., on *Butorides virescens bahamensis* (H.S. Peters). — Cuba: without precise locality (P. Poey). — Isle of Pines: Los Indios, on *Guara alba* (G. Link). — Jamaica (recorded by Walker, 1849, as *O. propinqua;* Thompson, 1949): without precise locality (Walker's ♀ type of *propinqua*); near Salt I., St. Catherine, on *Casmerodius albus egretta* (F. Romney); Black River, St. Elizabeth, on *Leucophoyx t. thula* (R.P. Bengry); Rio Cobre Irrigation Canal, Grove Place, St. Catherine, on *Ardea h. herodias* (G.B. Thompson); Bowden, St. Thomas, on *Nyctanassa v. violacea* (G.B. Thompson); Falmouth, on *Butorides virescens maculatus* (H.D. Carroll). — Puerto Rico (recorded by Wolcott, 1924, 1936, 1941, 1951): Río Piedras (A. Wetmore).

Colombia: Don Diego, Dept. Magdalena (H.H. Smith); Intendencia del Meta, on *Leucophoyx t. thula* [*"Ardea nivea"*] (B. Guevara).

Venezuela (recorded by Lutz and Nuñes-Továr, 1928).

British Guiana: Takutu River, on *Theristicus caudatus* (J.G. Myers).

Brazil (recorded by Lutz, Neiva and da Costa Lima, 1915, as *O. palustris*): near Cachoeira, State Rio Grande do Sul, on *Anas brasiliensis* (W.F. Henninger); São Sebastião, State São Paulo; Lassance, State Minas Gerais, ♀ cotype of *O. palustris,* on *Ardea cocoi* (Mus.Comp.Zool., from Ad. Lutz); Parnaguá, State Piauhy including some cotypes of *O. palustris,* on *Mesembrinibis cayennensis, Casmerodius albus egretta, Tigrisoma lineatum marmoratum,* and *Leucophoyx t. thula* (Inst.Osw.Cruz); Martinho, State Matto Grosso, on *Leucophoyx t. thula* (T. Borgmeier); Cana Brava, State Goyaz (José Blaser); State São Paulo, on *Rhinoptynx c. clamator* (Juliani); Rio Paranapanema, State São Paulo, on *Tigrisoma linea-*

tum marmoratum (E. Dente); Pau Gigante, State Espirito Santo, on *Cochlearius c. cochlearius* (E.G. Holt); Rio Paraná, State Matto Grosso; Rio das Mortes, S. Domingos, State Matto Grosso, on *Eurypyga h. helias* (Werner). (Specimens for the last 5 records received from the Departamento de Zoologia, São Paulo, through Dr. L.R. Guimarães).

Galapagos (recorded by Johnson, 1924, as *O. intertropicus;* Curran, 1932, as *O. intertropicus*): Narborough I., on *Ardea herodias cognata* (M. Willows, Jr.); James I. (M. Willows, Jr.); North Seymour I. (M. Willows, Jr.); Tower I., on *Nyctanassa violacea pauper* (G. Augustson; W.S. Brooks); Seymour Bay, Indefatigable I., on *Butorides sundevalli* (W. Beebe); Albemarle I., on *Butorides sundevalli;* 10 miles S.W. of Elizabeth Bay, Albemarle I., on *Nyctanassa violacea pauper* (J.P. Chapin); Conway Bay, Indefatigable I., on *Butorides sundevalli* and *Larus fuliginosus* (J.P. Chapin).

Paraguay: Chaco (K. Fiebrig).

Argentina: Dept. Tucumán, Tucumán, 1 ♀ on *Syrigma sibilatrix,* July 10 (O. Budin).

L. albipennis is nearly cosmopolitan, but mainly in tropical and warm temperate regions, and is apparently one of the few insects that have become world-wide without the assistance of Man. Its northmost extension is in the New World, where it reaches 54° N. in Alberta. There is as yet no record from California, where it has no doubt only been overlooked. The southmost record is from 30° S., in southeastern Brazil. In the Old World, where it is usually called *L. ardeae,* it is particularly common in Africa, with definite records from Tunis, Egypt, the eastern Sudan, Eritrea, Northern Nigeria, Southern Nigeria, Gold Coast, Belgian Congo, Uganda, Kenya, Tanganyika Territory, Southern Rhodesia, Nyasaland and Transvaal. It is probably found normally in all countries bordering the Mediterranean, there being records from southern France, Italy, Sicily, Macedonia, Bulgaria, southern Russia and Rhodes. Its occurrence farther north is only accidental, as shown by the few sporadic captures in Czechoslovakia, East Prussia, the Netherlands, England and Ireland. Elsewhere in the Old World it is known also from Madagascar, southern Arabia, Siam, the Philippines, Australia, Manchuria (Yalu River), and Japan.

Known Nearctic Hosts of *L. albipennis* (verified individual records in parentheses). Ciconiiformes (82): *Ardea h. herodias* (3); *A. herodias occidentalis* (2); *Botaurus lentiginosus* (33); *Butorides v. virescens* (12); *Casmerodius albus egretta* (2); *Dichromanassa*

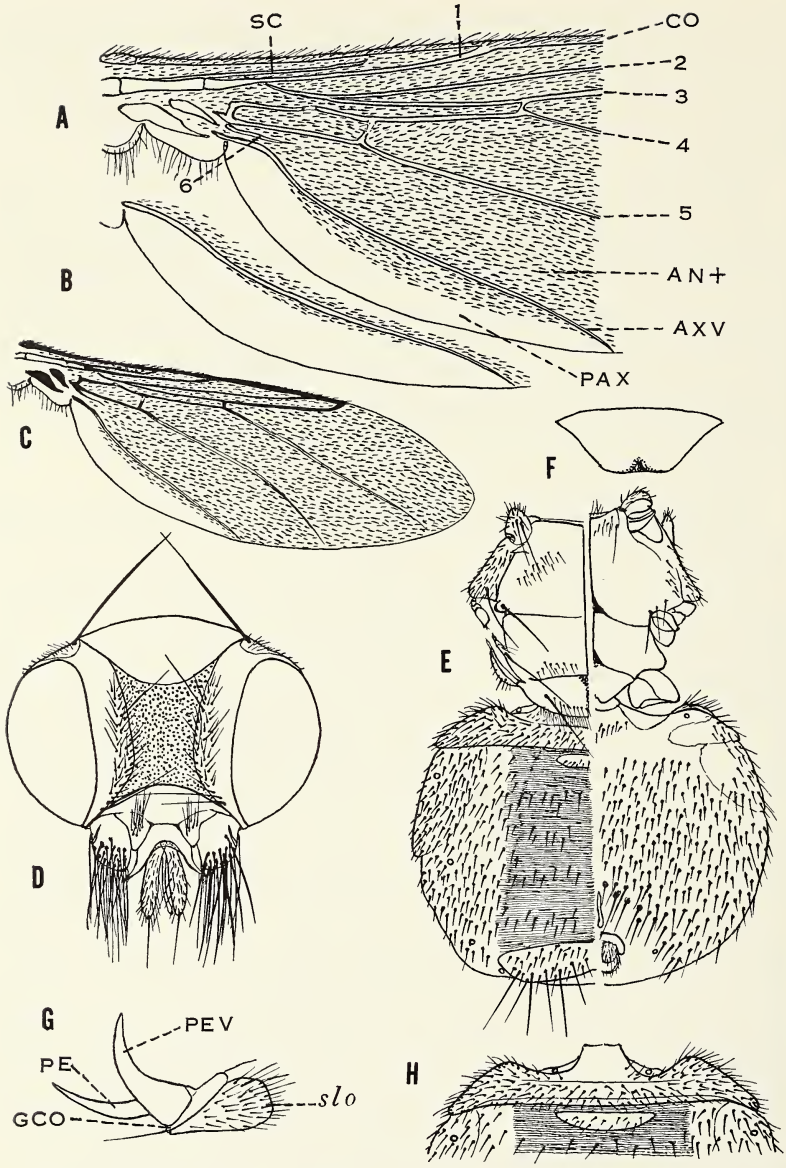

Fig. 63. *Lynchia albipennis* (Say). **A**, basal half of wing ♀, Ravalli Co., Mont., on *Botaurus lentiginosus: AN+*, combined anal, 3rd posterior and axillary cells; *AXV*, axillary vein; *CO, costa; PAX*, postaxillary cell; *SC*, subcosta; *1*, *2*, *3*, *4*, *5*, and *6*, 1st, 2nd, 3rd, 4th, 5th, and (remaining stump of)

r. rufescens (1); *Florida c. caerulea* (5); *Hydranassa tricolor ruficollis* (2); *Ixobrychus e. exilis* (9); *Leucophoyx t. thula* (1); *Mycteria americana* (1); *Nyctanassa v. violacea* (2); *Nycticorax nycticorax hoactli* (9). Anseriformes (1): *Anas crecca carolinensis* (1). Falconiformes (3): *Accipiter striatus velox* (1); *Falco s. sparverius* (1); *Pandion haliaetus carolinensis* (1). Gruiformes (4): *Gallinula chloropus cachinnans* (2); *Porphyrula martinica* (1); *Porzana carolina* (1). Charadriiformes (2): *Tringa melanoleuca* (2). Strigiformes (1): *Tyto alba pratincola* (1). Passeriformes (1): *Piranga r. rubra* (1).

Known Neotropical Hosts of *L. albipennis.* Ciconiiformes (30): *Ardea cocoi* (1); *A. h. herodias* (1); *A. herodias cognata* (1); *A. herodias occidentalis* (1); *A. herodias sanctilucae* (1); *Botaurus lentiginosus* (1); *Butorides sundevalli* (3); *B. virescens bahamensis* (1); *B. virescens maculatus* (1); *Casmerodius albus egretta* (2); *Cochlearius c. cochlearius* (1); *C. cochlearius panamensis* (1); *Guara alba* (1); *Leucophoyx t. thula* (4); *Mesembrinibis cayennensis* (1); *Mycteria americana* (1); *Nyctanassa v. violacea* (1); *N. violacea pauper* (3); *Syrigma sibilatrix* (1); *Theristicus caudatus* (1); *Tigrisoma lineatum marmoratum* (2). Anseriformes (1): *Anas brasiliensis* (1). Gruiformes (1): *Eurypyga h. helias* (1). Charadriiformes (1): *Larus fuliginosus* (1). Strigiformes (1): *Rhinoptynx c. clamator* (1).

The following list of known Old World hosts is based on unpublished as well as published records: Ciconiiformes: *Ardea c. cinerea; A. cinerea firasa; A. goliath; A. melanocephala; A. p. purpurea; A. s. sumatrana; Ardeola ralloides; Botaurus s. stellaris; Bubulcus i. ibis; B. ibis coromandus; Casmerodius albus melanorhynchus; C. albus modestus; Egretta dimorpha; E. g. garzetta; Ibis ibis; Ixobrychus m. minutus; I. sinensis astrologus; Mesophoyx i. intermedia; Nycticorax n. nycticorax.* Falconiformes: *Circus* sp. Charadriiformes: *Actophilornis africana; Xiphidiopterus albiceps.*

Bionomics. In the New as well as in the Old World, *L. albipennis* is primarily a parasite of wading birds (Ciconiiformes), with

6th longitudinal veins; **B**, axillary vein and postaxillary cell, ♀, Ancon, Panama; **C**, wing, ♂, Indefatigable I., Galapagos, on *Butorides sundevalli;* **D**, head, ♀, Philadelphia, Pa., on *Botaurus lentiginosus;* **E**, thorax and abdomen dorsally and ventrally, ♀, Ravalli Co., Mont., on *Botaurus lentiginosus;* **F**, postvertex, ♀, Narborough I., Galapagos, on *Ardea herodias cognata;* **G**, ♂ terminalia, Brookings, S. Dak., on *Ixobrychus e. exilis: GCO,* rudiment of gonocoxite; *PE,* penis; *PEV,* penis valve; *slo,* setigerous lobe at side of genital atrium; **H**, dorsal basal area of abdomen, ♂, Puerto Castilla, Honduras, on *Ardea herodias occidentalis.*

89 per cent of the verified individual records of the New World referring to this Order Such birds appear to be its only regular breeding hosts. Although it strays occasionally to other birds with a similar ecology (Charadriiformes, Gruiformes, Anseriformes), which also prefer a marshland or aquatic environment, particularly for nesting, it is doubtful whether any of these serve as normal breeding hosts, in view of the few sporadic records. On other types of recorded hosts, such as owls, diurnal birds of prey and tanagers, the fly is clearly accidental and some of the records from them may be based on *post mortem* contaminations. The nearly cosmopolitan distribution of *L. albipennis* is no doubt due to the powerful flight of its regular breeding hosts, some of which undertake wide-ranging migrations or occur in several races on all continents.

At present the overwhelming majority of verified American records are from some of the smaller wading birds, such as bitterns (*Botaurus, Ixobrychus*), green herons (*Butorides*) and night herons (*Nycticorax, Nyctanassa*). This is due, however, to the vagaries of collecting, not to any real preference shown for such birds. Hippoboscids are much more difficult to collect from the larger wading birds, some of which, moreover, are often rare or restricted in distribution.

Some of the ecological peculiarities of *L. albipennis* were mentioned in Part I, such as infestation with mites (pp. 146 and 156), phoresy of Mallophaga (p. 173) and host preferences (pp. 252 and 320).

In temperate North America *L. albipennis* seems to be absent during the winter. Most flies were collected there during May, June, July, August and September, and a few also in April and October. In the northern United States the earliest recorded date is April 8 (New York) and the latest December 7 (Ohio); but farther south there are also records in Louisiana for November 21 and December 14, and in Florida for February 5 and November 8. In the more northern parts of its range the fly must probably be introduced anew every spring on migrant hosts.

The following may be added to the 6 cases listed before of infestation with mites:

7. A female from Florence, South Carolina, taken on *Florida c. caerulea,* carried 2 mite clusters on the abdomen; a male taken with it was free of mites.

8. A female from Lincoln, Nebraska, (paratype of *O. botaurinorum*), taken on *Botaurus lentiginosus*, carried a female mite, without eggs, on the side of the abdomen near the tip.

Fig. 64. *Lynchia albipennis* (Say), basal area of wing, ♂, Chicago, Ill., on *Botaurus lentiginosus*. Photograph by Mr. K. MacArthur (1948, fig. 250).

The puparium, as well as its location in nature, are as yet unknown.[48]

Affinities. In the present paper the small specimens of *Lynchia* normally found on wading birds throughout the world, are considered to belong to a single, cosmopolitan species, under the oldest available name, *L. albipennis* (Say). This conclusion was reached after studying over 400 specimens from a large variety of waders over a very wide territory, as it was found impossible to divide these consistently on constant and reliable structural differences. It was

[48] The statement in Part I (p. 194) about the supposed occurrence of the puparium in the nest of the European bittern should be deleted. It was taken from Brauer (1883, p. 93), who credited it to Schiner (1864, **2,** p. 647) ; but I have been unable to find it either in the work quoted by Brauer or in any other of Schiner's writings.

therefore necessary to synonymize with *albipennis* 6 names based by later writers on flies from the same type of host, as well as one (*O. propinqua*) from an unknown host. The synonymies are further discussed below in connection with the original descriptions.

In *L. albipennis* the course of the subcosta varies more than usual in the genus. As it is easily observed, one may be tempted to use its variations to subdivide the species; but the following considerations show that it is unreliable for this purpose.

A random sample of 77 New World specimens may be divided as follows:

a. Flies with subcosta complete (ending clearly in the costa) in both wings (Fig. 63*C*) : 37 (20 ♀ and 17 ♂), from Quebec, Florida, Kansas, Massachusetts, Michigan, Minnesota, Nebraska, New York, Pennsylvania, South Carolina, Texas, Panama, Jamaica, Colombia, Paraguay, Brazil and Galapagos, taken on *Anas crecca carolinensis, Ardea h. herodias, A. herodias cognata, Botaurus lentiginosus, Butorides sundevalli, B. v. virescens, Hydranassa tricolor ruficollis, Leucophoyx t. thula, Nyctanassa violacea pauper, Nycticorax nycticorax hoactli, Syrigma sibilatrix,* and *Tigrisoma lineatum marmoratum.* This group includes several of the cotypes of *O. palustris;* but, as Lutz, Neiva and da Costa Lima (1915) noted, in other cotypes the subcosta was incomplete and they concluded that the character was unreliable.

b. Flies with subcosta incomplete (ending freely in the membrane) in both wings (Fig. 63*A*) : 27 (16 ♀ and 11 ♂), from Quebec, Illinois, Massachusetts, Michigan, Minnesota, Montana, Nebraska, New Jersey, New York, Pennsylvania, South Dakota, Wisconsin, Honduras, Brazil and Galapagos, taken on *Anas crecca carolinensis, Ardea herodias occidentalis, Butorides v. virescens, Botaurus lentiginosus, Florida c. caerulea, Ixobrychus e. exilis, Nycticorax nycticorax hoactli* and *Pandion haliaetus carolinensis.* This group includes the types of *O. botaurinorum* and *O. scutellaris.*

c. Flies with the subcosta complete in one wing and incomplete in the other: 14 (9 ♀ and 5 ♂), from British Columbia, Ontario, Florida, Massachusetts, Missouri, North Carolina, Ohio, Texas, Wisconsin, Jamaica and Brazil, taken on *Ardea herodias occidentalis, Botaurus lentiginosus, Butorides v. virescens, Dichromanassa r. rufescens* and *Totanus melanoleuca.* While in most of these flies the vein is abruptly cut off and distinctly separated from the costa, in some the separation is very narrow or almost imperceptible, particularly when the vein becomes gradually thinner at the tip. The two conditions intergrade so completely that some flies have to be

Fig. 65. *Lynchia albipennis* (Say), terminalia of ♂, Chicago, Ill., on *Botaurus lentiginosus*. Photograph by Mr. K. MacArthur (1948, fig. 251).

placed arbitrarily; such is the case, for instance, for the type of *O. propinqua*, as discussed in the sequel.

While the total number of flies examined is too small for further statistical analysis, it is nevertheless significant that the costa is incomplete in both wings in about half of them, complete in both wings in about one-third, and incomplete in only one wing in less than one-fourth. None of the three groups shows any tendency to prefer a special geographical area or a particular type of host. In fact, all three groups have been found on *Ardea herodias, Botaurus lentiginosus* and *Butorides virescens;* while *Anas crecca* and *Nycticorax nycticorax* are represented in two of them. A study of additional Old World flies from waders leads to the same results.

Of particular interest are cases in which 2 or more flies taken from the same individual bird differ in this character. Of 2 ♀ from São Sebastião, Brazil, taken together on an unknown host, one had the subcosta incomplete in both wings, the other had it complete in one wing and incomplete in the other. Of a pair taken at Kamouraska, Quebec, on *Anas crecca carolinensis*, the ♂ had the subcosta

complete, and the ♀ had it incomplete in both wings. Of 2 ♀ of Delmar, N.Y., from *Nycticorax nycticorax hoactli,* one had it complete and the other incomplete in both wings.

It should be pointed out that it has been impossible to correlate with any degree of certainty the type of subcosta with the variations of other characters, to be discussed presently.

When the subcosta is complete, the position of its tip on the costa in relation to that of the anterior basal cross-vein is most variable. Often it is nearly opposite the cross-vein (Fig. 63*C*); but sometimes it is slightly basad or decidedly apicad. When the vein is incomplete, it usually ends about opposite the cross-vein (Fig. 63*A*); but sometimes it is shortened and may then stop in the membrane far basad of the cross-vein.

While the postvertex does not vary as much in contour as in *L. americana*, its anterior margin shows considerable variation. All stages may be observed connecting the two extremes, from completely smooth, merely rounded truncate and only slightly depressed at apex (Fig. 63*D*) to deeply emarginate, with the roughly triangular notch coarsely punctate (Fig. 63*F*).

The sexes differ little, the width of the interocular face in particular being about the same in both. The dorsum of the abdomen of ♀ and ♂ bears in the striated area one smooth median sclerite, a short distance apicad of the fused basal laterotergites; this sclerite is larger in the ♂ (Fig. 63*H*), being relatively wider (transversely) than in the ♀. The median sclerite may escape observation, as it is sometimes hidden beneath the hind margin of the basal laterotergites through contraction of the soft integument (as in Ferris' figure of *L. setosa*, 1927*c*, p. 227).

Original description of *O. albipennis:* "Blackish-brown; wings whitish. Mentum white; thorax with the cruciate lines distinct, the longitudinal line tinged with yellow, humeral tubercle prominent, pale, obtuse; scutel with an impressed line; nervures brown, inner cellule [2nd basal cell] less than half as long as the preceding one [1st basal cell] which extends to the base of the wing; tergum pale-brownish, with a black base, disk and tip. Length $\frac{1}{5}$ inch [=5 mm.]." The type is lost, so far as known. That the species belongs in the genus now called *Lynchia,* is shown by Say's placing it in *Olfersia* (which at that time contained the species now placed in *Lynchia*) and by his statement that the 2nd basal cell is considerably shorter than the 1st. The size he gives refers it to one of the smaller species; but the description mentions no truly specific character. The other North American small species, *L. angustifrons, L. hirsuta* and *L. holoptera,* may, however, be ruled out, if it is accepted that only one species of *Lynchia* breeds normally on North American wading birds. If, however, these birds were found to harbor two or more small species of *Lynchia,* as Swenk (1916) thought, Say's name should be applied arbitrarily to one of them. Swenk actually did this by selecting and redescribing as "neotype" a ♀ taken on *Butorides v. virescens* at Lincoln, Nebraska. For the con-

venience of future workers, who may be inclined to agree with Swenk, I copy his new description, based in part also on two flies taken at Lincoln on *Nycticorax nycticorax hoactli* (cited by him as *N. n. naevius*): "Length 5 mm., the head and thorax alone measuring 2.75 mm., and the distance from the front of the head to the tip of the wing measuring 7 mm., the thorax being 2 mm. wide at the widest part. Head and thorax blackish-brown. Head elliptical, nearly $1\frac{1}{2}$ times as wide as long, the [interocular] face about twice as broad as the eyes and narrowing anteriad, the rather broad orbital margins and the semicircular, uniformly convex vertex [postvertex] smooth and polished, leaving a subtrapezoidal, opaque median area [mediovertex]. Inner edges of the polished orbital margins [inner orbits] more or less hairy. Clypeus [frons] $\frac{7}{10}$ as long as the front [mediovertex], usually rather shiny, divided into two sections by a deep, median, transverse sulcation, the apical section rather broad and anteriorly broadly and shallowly emarginate, so that its visible basal width along the dividing sulcation is fully one-half of the distance across the emargination between the lateral apices. Antennary processes brownish-black and bearing long ferruginous and black hairs. Palpi blackish, subequal to the clypeus [frons] in length, copiously clothed with short, pale hairs. Eyes shining blackish. Humeral processes short and heavy, their tips obtuse, in color a yellowish-testaceous distinctly paler than the coloration of the rest of the thorax above, bearing several short blackish hairs and one long black bristle. Mesonotum with a distinct, impressed, median longitudinal line and straight, deep, transverse, median sulci which are but slightly if at all interrupted medially, the whole having a distinct cruciate form. Mesonotum anteriorly with very few, long, pale ferruginous hairs. Scutellum posteriorly broadly rounded, its apical margin finely rimmed and thinly provided with short, pale hairs, a deep median longitudinal sulcus giving it a sub-bilobed appearance. Pleura opaque and grayish because of a thin pollinosity over the dark brown integument. Under side of head brown, the labium [basement membrane] whitish. Sternum flat, shining, dark brown, the anterior angles prominent and extending as short contrastingly black lobes between the anterior coxae. Legs dark brown, below finely pale-haired, above sparsely black-haired, the claws black. Tergum light brown, darkening laterally, the base and apical portion together with a medioapical stain, blackish, venter light brown, the whole abdomen thinly short-haired, these varying in color from pale at the base to blackish toward the tip of the abdomen, tergum with two latero-apical tufts of long, black hairs. Wings whitish, the costal veins and basal part of the longitudinal veins dark brown, the costa only moderately thickened beyond the end of the 1st vein which joins the costa a little before the 1st crossvein [anterior cross-vein], the costal border of the marginal cell $1\frac{1}{3}$ times as long as the costal border of the 1st submarginal cell, the 1st basal cell over twice as long as the 2nd basal cell." Swenk also mentions a variety, from Lincoln (host unknown), "having the scutellum with the median longitudinal sulcus very weak, so that the scutellum is not at all sub-bilobed in appearance, and the vertex [postvertex] with a large, shallow anterior concavity (this is feebly marked in typical *albipennis*)." I have seen Swenk's specimens at the University of Nebraska in 1940 and again in 1953. They are females and have the subcosta of the wing complete, ending in the costa, in both wings.

Original description of *O. ardeae* (translated from the French): "Length, 2 [French] lines [= 4.5 mm.]. Shiny black. Face and palpi testaceous. Thorax with an impressed dorsal line. Legs brownish testaceous. Wings fuliginous." So far as could be traced, the type of *O. ardeae* is lost. The species was first recognized by Schiner (1853) in 3 flies taken from a European bittern, *Botaurus stellaris*, in Moravia (formerly in Austria, now a part of Czechoslovakia). In 1864, Schiner gave the following description, copied here (translated from the German), because it is more complete than Macquart's, although no structural characters are included: "Shiny black; thorax with a pale-brown, impressed

dorsal line [median notal suture]; abdomen brown, the sides reddish-yellow; [interocular] face blackish-brown, paler toward the antennae; antennae, palpi and legs sometimes pale, sometimes dark horn-brown; femora always palest at the base; claws pitch-black; wings blackish. 3 [Austrian] lines [= 6.5 mm.; evidently the total length to the tips of the wings folded over the abdomen].'' Following Schiner Macquart's trivial name *ardeae* has been used since 1864 for the common small *Lynchia* of Old World waders. It is, however, not possible to separate this from the New World parasite of waders, Say's *albipennis*, by any reliable structural peculiarity. Say's earlier name (1823) therefore supersedes that given by Macquart (1835).

Original description of *O. propinqua:* ''Viridi-picea, capite antico pallidiore, pedibus fulvis, femoribus nigro subvittatis, tarsis piceis, alis fuscis. Body pitchy, smooth, shining; shoulders, front of the head and mouth paler; sides of the crown metallic green; chest more slightly metallic: tip of the abdomen beset with a few black bristles: legs tawny; thighs slightly streaked with black; feet pitchy; claws black; wings brown; wing-ribs and veins pitchy. Length of the body 1½ line [= about 3.5 mm.]; of the wings 5 lines [= span of wings, about 11.5 mm.].'' Walker mentions only one specimen, now marked as type at the British Museum. This is a female which I studied in 1951 and was unable to separate from other specimens of *L. albipennis*. According to Dr. G. B. Fairchild (*in litt.*, 1953), the wing is 4.8 mm. long; the subcosta is incomplete in the right wing, complete or nearly so in the left, though weaker at the costa. A second specimen of the same species, also from Jamaica and probably dating from Walker's time, now stands with the type. Austen also had placed with it the male paratype of van der Wulp's *O. coriacea*, from Presidio, Mexico, which he had recognized correctly in 1903 as cospecific with *O. propinqua*.

Original description of *O. botauri:* ''Statura paulo minor *O. ardeae*, et praecipue distincta, colore corporis sub-testaceo, non nigricante piceo; pedibus pallidis non fuscis: Abdomine toto sordide lutescente, basi tantum obscura; et alis albicantibus non infuscatis, venis rufescentibus non nigricantibus ec. Tamen longitudine venae tertiae, et praesentia transversae interioris, aliisque notis, similis *ardeae*.'' Dr. B. Lanza informs me (*in litt.*, 1953) that the type, labelled as from Liguria, is now in Rondani's Collection at the Natural History Museum in Florence. Although it has not been studied critically, there can be little doubt that it is cospecific with *L. albipennis*.

Original description of *O. palustris* (translated from the Portuguese): ''Length of body 5 mm.; of head and thorax combined 3 to 3½ mm.; of wing 7 mm. [erroneous, as shown below]. General color chocolate, partly with metallic gloss. Wing with the bare area restricted to the axillary [= postaxillary] cell. Head very wide, the length much less than the width. Surface of palpi honey-yellow, covered densely with black hairs; process of clypeus short, forming an obtuse angle; ferruginous on the frons, turning black behind. Antennae: process shiny black and with hairs; apex and basal process honey-yellow, finely granulose; frontal triangle medially with a linear depression, its surface yellow, somewhat infuscated and very shiny; other margins of frons dark, with bronzy and greenish gloss; triangle of vertex [postvertex] truncate at the frons and on the whole rounded, with a small superficial depression in the middle of the anterior margin; lateral margins of frons [inner orbits] with a row of yellow ciliae and some larger bristles, two at the frons, one in the middle of each side, crossing each other over the occipital triangle, and another at the occipital margin; dull part of frons broad, but more elongate and narrower over the anterior half. Under side of head shiny infuscate-yellow; membrane below the proboscis the color of parchment. Mesonotum with a bronze-green gloss, some golden-yellow hairs and fine striae at the periphery, converging toward the center; humeral callosities ochraceous-gray; spiracles forming a white spot posteriorly; median notal suture almost linear, accompanied by two reddish lines, which are fainter anteriorly; transverse mesonotal suture deep, effaced over a small stretch medially; lateral areas of mesonotum,

before the scutellum, somewhat depressed and less shiny. Scutellum divided in the middle; the furrow little widened anteriorly, more so posteriorly; gloss as on mesonotum; hind margin with 2 rows of golden-yellow ciliae, one premarginal, rather indistinct, the other marginal, stronger. Humeral callosity with short, black spines; squamular process with longer spines; in addition, various dark bristles, distributed over outer area of thoracic dorsum. Abdomen chocolate color, with fine golden-yellow hairs and some postero-lateral dark bristles; some yellowish spots near anus and beneath. Legs chocolate color, turning olivaceous-gray over distal parts and beneath. Sternum glossy reddish-gray. Wings with yellowish ground-color, slightly infuscated by microscopic hairs [microtrichia]; heavier veins chestnut, the other yellowish; auxiliary vein [subcosta] variable, not always reaching costa; a golden-yellow ridge between bases of 4th and 5th veins; alula small; upper calypter well developed, lower calypter rudimentary.'' The length given for the wing (7 mm.) is clearly out of proportion with the other measurements. As the figures of Pl. 28 are all said to be enlarged 9½ times, the true length of the wing must be about 5.4 mm., which agrees with the several cotypes of *palustris* I have examined. One of these was presented to the Museum of Comparative Zoology some years ago by the late Dr. Ad. Lutz; others were received for study more recently from the Instituto Oswaldo Cruz through the kindness of Dr. H. de Souza Lopes. The wings of these cotypes are from 5.3 to 6 mm. long. Before seeing them, I was misled by the erroneous wing length originally given and, in one of my early papers (1933*b*, p. 71), attempted to recognize *O. palustris* among the larger species of *Lynchia*. Consequently, I then referred to it an African fly of cormorants. The error was corrected later (1945 *b*, p. 96), when it was stated that *palustris* was one of the small species of *Lynchia*, ''very closely related to, or possibly even identical with, *Lynchia albipennis* (Say).'' Further study of additional material from waders leaves no doubt that *palustris* is identical with *albipennis*, the only South American small *Lynchia* with only the postaxillary cell extensively or almost completely bare.[49]

Original description of *O. botaurinorum:* ''Very similar to *O. albipennis* Say, above redescribed, but distinctly larger, the length of the head and thorax measuring 3.25 mm., the width of the thorax at its widest part 2.5 mm., and the distance from the front of the head to the tip of the wing 8 mm. Color of head and thorax darker, more blackish, the color of the humeral processes not distinctly paler than that of the rest of the thorax above. Head less broad, 1¼ times as wide as long, the apical section of the clypeus [frons] comparatively narrow at base and rather deeply emarginate at apex, so that the visible basal width along the dividing sulcation is not more than ⅓ of the distance across the emargination between the lateral apices. Antennary processes black and bearing much black hair. Face without obvious hair along orbital margins and mesonotum likewise not hairy. Wings faintly clouded. First vein joining the costa considerably before the 1st crossvein [anterior cross-vein]. Otherwise agreeing with the preceding description of *O. albipennis*. It is possible that this form is conspecific with *A. ardeae* Macquart, but after a careful comparison with the description I have decided to let it stand as distinct. Certainly the wings are not as dark as described for *ardeae*.'' I was able to study the holotype and 2 paratypes, all females, at the University of Nebraska in 1940 and again in 1953. The only structural difference I was able to detect

[49] The large Old World *Lynchia* of cormorants, which I called *L. palustris* in 1933, was later described as *Lynchia schoutedeni* J. Bequaert (1945*b*, p. 93). I now suspect that it will eventually be recognized as identical with *Lynchia massonnati* Falcoz (1926, p. 31), based on the fly from France erroneously referred to *L. americana* by Massonnat (1909, p. 304).

between these flies and those called *albipennis* by Swenk, was in the extent of the subcosta, a character, moreover, not mentioned by the author. The subcosta is incomplete in both wings in all 3 types of *botaurinorum*, stopping some distance from the costa. In the discussion of the affinities I pointed out that this character is unreliable for the separation of species among the small *Lynchia* of waders. The wing of the holotype of *botaurinorum* is 5.8 mm. long.

Original description of *O. scutellaris:* "Resembling *O. albipennis* Say, but differing from that species, as above described, in the following characters: Somewhat larger, the length about 5 mm., the head and thorax alone measuring 3 mm., the thorax being nearly 2.5 mm. wide at the widest part, and the distance from the front of the head to the tip of the wing measuring 7.5 mm.; head less broad, subcircular, the width only $1\frac{1}{6}$ times the length, the face very broad, fully $2\frac{1}{2}$ times as broad as the eye; elevated orbital margins opaque or slightly shiny along extreme outer edges only, their inner edges distinctly hairy; clypeus $\frac{4}{5}$ as long as front, the apical section shaped as in *O. botaurinorum* but with the base slightly wider, so that it is slightly more than $\frac{1}{3}$ ($\frac{3}{8}$) of the distance between the lateral apices; antennary processes blackish and bearing much black hair, the palpi slightly shorter than the clypeus; eyes dull plumbeous; each side of scutellum with a long black bristle; wings slightly darker, the 1st vein joining the costa considerably before the 1st crossvein; coloration of head and thorax brownish fuscous, the shiny vertex and basal portion of the median longitudinal line stained with reddish, the tips of the tubercles and the scutellum reddish yellow, the latter contrasting strongly with the much darker mesonotum. This species is even closer to *O. botaurinorum*, just described, than to *O. albipennis*, agreeing with the former in size, clypeal structure and venation, but easily separated by the more brownish general coloration, yellowish scutellum, hairy face and mesonotum, broader front, opaque orbital margins and dull-colored eyes." The ♀ holotype, seen at the University of Nebraska in 1940 and 1953, agrees with the types of *botaurinorum* in the incomplete subcosta in both wings and in all other structural characters. In particular, the inner orbits (Swenk's "orbital margins") are equally setulose ("hairy") in all these types, with setae in 2 or 3 irregular rows; but some of the setae may be broken and indicated only by their insertions. I could detect no appreciable difference in the width of the frons basally (Swenk's "clypeus").

Original description of *L. setosa:* "*Male.* Length on slide, 5.5 mm.; length of wing, 5 mm. A very dark species. Head rather small and rather short and broad, the clypeus [frons] deeply emarginate anteriorly, but the lateral arms only slightly exceeding the antennae; vertical triangle [postvertex] not emarginate or incised anteriorly; ventral side of the head with numerous setae. Thorax noticeably broad and laterally angulate; humeral angles (humeral callosities) short and very broad. Legs with a notable paucity of large setae and a notable abundance of extremely small setae, the surfaces being almost entirely covered with the latter. Wings with the venational type common to the genus but the subcosta not attaining the costa; entirely covered with setulae, excepting only a portion of the area behind the anal vein, this vein itself, and vein $M_3 + Cu$ [5th longitudinal]. Abdomen devoid of all but the usual basal and apical tergites; bearing numerous small setae which are not borne on tubercules, or at the most with such tubercules extremely inconspicuous. — *Female.* In all respects essentially identical with the male, the only dimorphism being in the position of the genital opening which is closer to the apex of the body, in the absence of the very minute claspers of the male, and the presence of a very small tergal plate just caudad of the basal tergite. — I somewhat suspect this species of being *L. nigrita* (Speiser), although the only clues to the identity of the latter, which was described from Manila without any indication of host, are to be found in the note as to its dark color and the statement that the humeral callosities are 'sehr auffallend stump, wenig spitzer als ein rechter Winkel'." Before seeing the types, I had reached the conclusion, from the description and figures, that *L. setosa* was most probably the common, world-

wide, small *Lynchia* of wading birds. The discrepancies, such as the lack of median sclerite behind the basal laterotergites of the abdomen in the ♂, the nearly parallel-sided interocular face and the noticeably broadened and laterally prominent thorax, seem to be due either to contraction of the soft areas of the abdomen or to flattening by pressure of the cover-glass on the slide mount. A recent study (1953) of the holotype (♂) and allotype (♀), at Stanford University, has convinced me of the correctness of this view. I have also examined the additional specimens from the Philippines referred by Ferris later (1930) to his *setosa*. All are in my opinion cospecific with *L. albipennis*. Whether or not *Olfersia nigrita* Speiser (1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 358. — No sex; no host. Philippines: Manila. Type at Vienna Mus.) is the same species, as Ferris suggested, cannot be decided from Speiser's description.

Lynchia hirsuta Ferris

Figs. 51 and 66 *A–G*

Lynchia hirsuta Ferris, 1927, Canad. Entom., **59**, p. 249, figs. 1 (♀; mislabeled *L. americana*, but corrected by Ferris, 1929) and 4*A–D* (California: Stanford University, ♀ holotype and ♂ allotype, on *Lophortyx c. californica;* Altadena, ♂ paratype on *Toxostoma r. redivivum*. All types in Museum of Stanford University, Palo Alto, California); 1929, *Op. cit.*, **61**, p. 285. O'Roke, 1929, Science, (N.S.), **70**, p. 432 (transmission of *Haemoproteus lophortyx*); 1930, Univ. California Publ. Zool., **36**, pt. 1, p. 12, figs. *A–B*, after Ferris, 1927 (California: Mt. Hamilton; Mt. Diablo; on *Lophortyx c. californica;* puparium; vector of *Haemoproteus lophortyx*); 1932, California Fish Game, **18**, p. 230, fig. 50 (California: Berkeley Hills between Berkeley and Orinda). Rawson, 1934, Scientific Monthly, **39**, p. 504. Sumner, 1935, California Fish Game, **21**, p. 244 (California: Sa. Cruz Mts., on *Lophortyx c. californica*). Herman and Glading, 1942, *Op. cit.*, **28**, p. 150, fig. 45 in part (smaller of 2 flies). Benbrook, 1943, in Biester and Devries, Diseases of Poultry, 1st Ed., p. 615. Herman, 1944, Jl. of Parasitology, **20**, p. 114 (California: Orange Co., on *Lophortyx c. californica*); 1945, California Fish Game, **31**, p. 20 (infestation with *Myialges* mites).[50] Benbrook, 1948, in Biester and Schwarte, Diseases of Poultry, 2nd Ed., p. 733. Herms, 1950, Medical Entomology, 4th Ed., p. 414. Tarshis, 1952, Bull. Brooklyn Ent. Soc., **47**, pp. 69, 70, and 78 (on trapped *Lophortyx c. californica* in California); 1953, Summary of Dissertation, Berkeley, California, p. 1. Furman and Tarshis, 1953, Jl. of Parasitology, **39**, p. 70 (California: on *Lophortyx c. californica;* flies infested with *Myialges anchora*, from Bitterwater, Hunter Liggett Military Reservation and San Pablo Dam; flies infested with *Microlichus lophortyx*, from Bitterwater). Reichenow, 1953, in Doflein, Lehrbuch d. Protozoenkunde, 6th Ed., p. 894. Tarshis, 1954, Psyche, **61**, p. 58 (technique); 1955, Experimental Parasitology, **4**, No. 5, pp. 464–492, fig. 3 (experiments with *Haemoproteus lophortyx*).

Distribution and Specimens Examined. UNITED STATES. CALIFORNIA (recorded by Ferris, 1927; O'Roke, 1930, 1932; Sumner, 1935; Herman, 1944, 1945; Tarshis, 1952, 1953; Furman and Tarshis, 1953): [without precise locality, on *Lophortyx g. gambelii* in captivity (C.M. Herman, *in litt.*, 1945)]; Harbin Springs, Lake Co., on *Junco oreganus thurberi* (J. Maillard); Castle Hot Springs,

[50] Fig. 10*B* shows *Ornithoica vicina* (Walker), not *Lynchia hirsuta* as captioned.

Lake Co., on *Pipilo fuscus carolae* (J. Maillard); Chiles Ranch, Chiles Valley, Napa Co., on *Lophortyx c. californica,* June 8, 22 and 30, July 14, 15, 26 and 27, Aug. 18, and Nov. 4, 5, 6, 8 and 11 (I.B. Tarshis, C.M. Herman and A. Hightower; Mill Valley, Marin Co., on *Lophortyx californica brunnescens* (E.S. Ross); Mt. Diablo, Contra Costa Co., on *Lophortyx c. californica,* July 7 (E.C. O'Roke); San Pablo Dam, Orinda, Contra Costa Co., on *Lophortyx californica brunnescens,* June 21, Oct. 30, and Nov. 3 (I.B. Tarshis and A. Hightower); Lafayette, Contra Costa Co., on *Lophortyx californica brunnescens,* Nov. 7 (I.B. Tarshis); Concord, Contra Costa Co., on *Cyanocitta stelleri frontalis* (E.C. O'Roke); Sa. Cruz Mts., San Mateo Co., on *Lophortyx c. californica* (E.L. Sumner, Jr.); Oakland, Alameda Co., on *Lophortyx c. californica* (B. Cain); Stanford Universersity, Palo Alto, Sa. Clara Co., ♀ holotype and ♂ allotype on *Lophortyx c. californica,* Oct. 21 and Dec. 14 (C.D. Duncan and E. Quayle); Watsonville, Sa. Cruz Co., on *Lophortyx californica brunnescens,* Sept. 9 (I.B. Tarshis and Hightower); Hastings Reservation near Jamesburg, Monterey Co., on *Lophortyx c. californica,* July 15, Sept. 11 and 13, and Nov. 13, *Toxostoma r. redivivum,* July 24, and 9 flies on 4 *Pipilo fuscus crissalis,* June 23, July 18 and 29, and Sept. 6 (J.M. Linsdale); Jolon, Hunter Liggett Military Reservation, Monterey Co., on *Lophortyx c. californica,* Sept. 16, 17, 18, 19, 20, 21, 22 and 23, Oct. 1, 3, 11, 13, 18, 19 and 22, Nov. 12, 14, 17 and 19, and Dec. 8 (I.B. Tarshis, *et al.*); Bitterwater, 15 miles S.E. of King City, San Benito Co., on *Lophortyx c. californica,* Aug. 6, 7, 8, 9, 10, 11, 12, 13, 23, 25, 27, 28, 29 and 30, Sept. 21, 22, 23, 25, 27, 28, and 29, and Nov. 24 (I.B. Tarshis, *et al.*); Shandon, San Luis Obispo Co., on *Lophortyx c. californica,* Aug. 7, 13, 14, 16 and 24, and Sept. 2 (I.B. Tarshis and I. McMillan); Cedar Canyon, Cook Spring, Kern Co., on *Lophortyx c. californica,* Sept. 21, 22 and 23, and Oct. 17, 18, 19, 20 and 21 (I.B. Tarshis, *et al.*); Pomona, Los Angeles Co., on *Lophortyx c. californica,* June 1 (G. Augustson); Altadena, Los Angeles Co., ♂ paratype on *Toxostoma r. redivivum,* Sept. 20 (J.E. Law); Modjeska, Orange Co., on 3 *Lophortyx c. californica,* Aug. 14 (C.M. Herman); Hemet, Riverside Co., on *Oreortyx p. picta,* July 29 and 31, and Oct. 1 (Calif. Fish Game); Calipatria, Imperial Co., 1 ♀ on *Pipilo aberti dumeticolus,* July 28 (J.N. Belkin).—IDAHO: Boise, Ada Co., on *Dendragapus obscurus richardsoni* (F.C. Bishopp).—NEVADA: South Fork of Cherry Creek, Clan Alpine Mts., Churchill Co., Sept. 21, on *Centrocercus urophasianus* (H.T. Dalmat); vicinity of Reno, on *Centrocercus urophasianus* (H.E. Gallaway).—UTAH: Dove Creek, Box Elder Co., 8000 ft. (D.M. Rees).

L. hirsuta is exceptional among American hippoboscids for its very restricted distribution, as it is known at present only from about 113° W. to the Pacific Coast, in California, Idaho, Nevada and Utah. In California it ranges from Lake Co. (39° N.), to Imperial Co. (close to 33° N., the southmost known occurrence). It extends somewhat farther north in Idaho (to 43° 30′ N., the northmost record), Nevada (to 39° 30′ N.) and Utah (to close to 42° N.).

Known Hosts of *L. hirsuta* (verified individual records in parentheses). Galliformes (94): *Centrocercus urophasianus* (2); *Dendragapus obscurus richardsoni* (1); *Lophortyx c. californica* (82); *L. californica brunnescens* (6);[51] *Oreortyx p. picta* (3). Passeriformes (10): *Cyanocitta stelleri frontalis* (1); *Junco oreganus thurberi* (1); *Pipilo aberti dumeticolus* (1); *P. fuscus carolae* (1); *P. fuscus crissalis* (4); *Toxostoma r. redivivum* (2).—*Lophortyx g. gambelii* is not included in the list, because the only record is from a bird in captivity.

Bionomics. I discussed in Part I the host as an enemy of the fly (p. 130), the transmission of *Haemoproteus lophortyx* (pp. 138 and 358–360), infestation with mites (p. 158), the sex ratio (p. 179), larviposition (p. 194), the incubation period of the puparia (p. 199), mixed parasitism of the host with *Stilbometopa impressa* (p. 224), and the abundance of the fly on the host (p. 232). Dr. I.B. Tarshis has made many additional observations on these and other topics, publication of which is now in progress.

L. hirsuta is a specific, oligoxenous parasite of certain gallinaceous game birds, particularly California quail (*Lophortyx californica*), but also dusky grouse (*Dendragapus obscurus*), sage hen (*Centrocercus urophasianus*) and mountain quail (*Oreortyx picta*), all of which are regular breeding hosts. There is as yet no evidence that it lives in nature on Gambel's quail (*Lophortyx gambelii*). The few records (10 in all) from passerine birds are obviously due to accidental straying in nature, which should be expected in this case rather frequently in view of the abundance of the fly on quail in many localities. It is very common on at least one of its regular breeding hosts, particularly during summer and fall. The earliest date of capture on record is June 8 and the latest December 14.

[51] In the case of *Lophortyx californica*, the number of individual records here given is the total of the days on which flies were collected in different localities. Actually this number is only a small fraction of the number of birds found infested with the fly, as specimens were usually collected the same day from several quail. *L. c. vallicola* is here regarded as a synonym of *L. c. californica*.

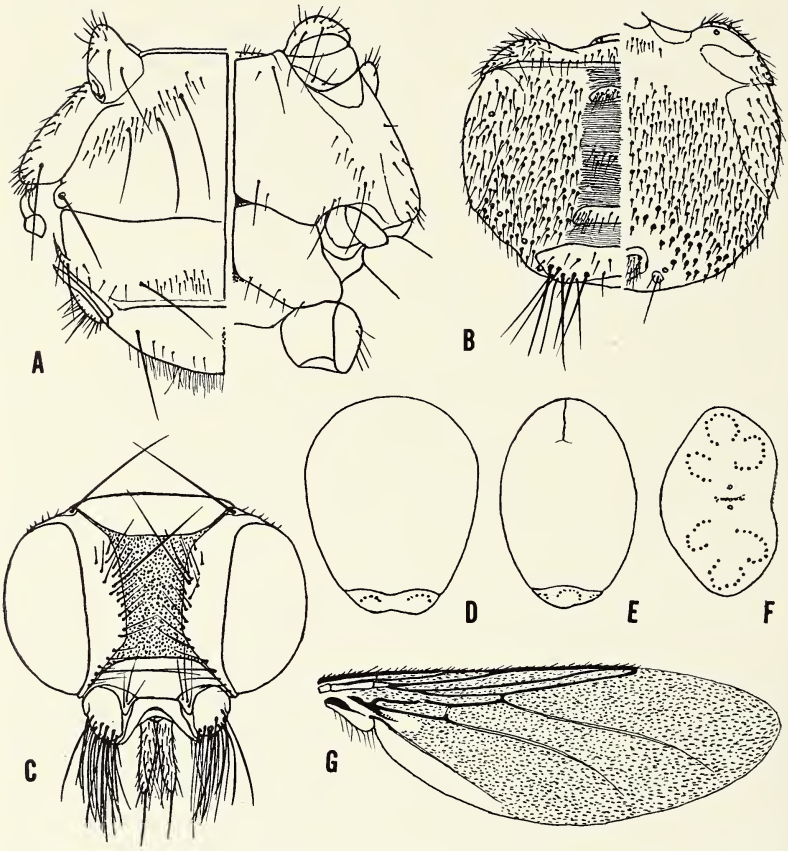

Fig. 66. *Lynchia hirsuta* Ferris. **A–C,** ♀, Bitterwater, Calif., on *Lophortyx c. californica:* **A,** thorax dorsally and ventrally; **B,** abdomen dorsally and ventrally; **C,** head. **D–F,** puparium bred on *Lophortyx c. californica* by Dr. I. B. Tarshis, from above (**D**), in side view (**E**) and respiratory lobes (**F**); **G,** wing, ♂, Hastings Reservation, Calif., on *Lophortyx c. californica.*

Sumner (1935, p. 244) found in the Sa. Cruz Mts., California, that between July 29 and October 7, 1933, at least one out of every five California quail harbored one or more *Lynchia*. He added that "at no time other than the season mentioned were hippoboscid flies found on quail, although the banding program, which involved handling large numbers of birds, would have revealed them had they been present." O'Roke (1930, p. 15) took flies in every month from June to October, the first being captured June 8. He stated, however, that hunters reported seeing flies on quail also in December and January. Dr. Tarshis and his associates, who investigated the occurrence of *L. hirsuta* on quail over a large area in California, found it only from June 8 to December 8. In the Chiles Valley area of California, where collection records are available on an annual basis, the fly was completely absent from January to May (Furman and Tarshis, 1953, p. 70).

Dr. Tarshis reached the conclusion that, in northern California at any rate, the adult fly disappears from quail early in December and that *L. hirsuta* most probably spends the winter in the pupal stage; but no puparia have as yet been found in nature. O'Roke (1930, p. 15) observed three larvipositions by females removed from quail and kept in vials; only one of these produced a fly, after an incubation period of 31 days. He also saw a pair in copulation on October 5. The puparium is as yet undescribed. My figures (Figs. 66*D–F*) and description are based on specimens raised from flies kept on quail in captivity by Dr. I.B. Tarshis. The mature puparium is much smaller that that of *L. americana*, about 2.2 mm. long, 1.8 mm. in greatest width and 1.4 mm. thick. It is also distinctively oval, not elliptical in outline, being narrowed behind toward the respiratory lobes, and equally convex dorsally and ventrally. Most of the surface is shagreened with the usual microscopic alutaceous sculpture. The cap bearing the respiratory lobes is barely raised, irregularly elliptical, not hexagonal in outline, the ventral margin only with a shallow inward curve. It is divided into two lateral areas by a shallow apical depression; on each half the minute, slightly raised respiratory pores are placed in three curved, bowlike groups, similar to those of *L. americana*, but with fewer pores in each group. The surface of the cap is almost impunctate, with only a few, minute, nearly imperceptible punctures, too small to be shown in Fig. 66*F*.

Furman and Tarshis (1953) recently published a detailed study of the mites infesting *L. hirsuta*. They found that in California of 900 flies taken from trapped quail (*Lophortyx c. californica*), 20,

or 2.2 per cent, were parasitized with mites, 18 harboring *Myialges anchora* Sergent and Trouessart and 2 carrying a new species, *Microlichus lophortyx* Furman and Tarshis (1953, p. 72, figs. 1–4). They also reached the conclusion that *Myialges* and *Microlichus* belong in the family Epidermoptidae (see Part I, p. 148). They retain the two genera, however, separating them in the female by the hysterosomal plate of the dorsum (present in *Microlichus,* absent in *Myialges*) and by the claw of tarsus II (present in *Microlichus,* absent in *Myialges*).

Affinities. *L. hirsuta* is easily recognized by the characters given in the key, particularly the peculiar stiff bristles in the setose patches of the prescutum, the bare postaxillary cell, and the two small median sclerites in the dorsal striated area of the abdomen. It is the only American species of *Lynchia* with two such sclerites, one placed immediately behind the fused basal laterotergites, the other slightly basad of the large, bristly apical tergite.

There is little variation in the shape of the postvertex, which is short and very wide, with a long straight anterior margin, not emarginate nor depressed apically, and the surface without pit.

The venation varies little. The subcosta is normally complete, ending in the costa (Fig. 66*G*). This is the case for both wings in 139 (75 ♀ and 64 ♂) of 142 flies collected at random in California on *Lophortyx californica.* In the remaining 3 ♀ (from Hemet and Bitterwater), the subcosta is complete in one wing and incomplete in the other. In addition, the subcosta was complete in 1 ♀ and 1 ♂ from *Pipilo fuscus* (California), 1 ♂ from *Dendragapus obscurus* (Idaho) and 1 ♂ from *Centrocercus urophasianus* (Nevada). Usually the subcosta ends in the costa opposite the anterior basal cross-vein or nearly so (Fig. 66*G*); occasionally it ends decidedly apicad of this cross-vein. The remaining stump of the 6th longitudinal vein is short, but distinct.

The sexual differences are slight. The relative width of the interocular face is about the same in both sexes. The two median dorsal sclerites of the abdomen are present in both sexes, but somewhat larger in the ♂ than in the ♀, being particularly wider (transversely). Ventrally the apical area of the abdomen of the ♀ bears very short setae on heavy tubercles, contrasting with the setae of the remainder of the venter; in the ♂ the insertion of the setae in this area is much less swollen and the setae are about as long as elsewhere. In addition, the ♀ has a soft setigerous knob between the ano-genital openings and the 7th abdominal spiracle, similar to that of *L. americana*, but much smaller and with fewer setae. The ♂

lacks this setigerous ventral knob. The setigerous lobe at each side of the genital atrium of the ♂ is shorter and narrower than in some other species of *Lynchia* of comparable size.

Original description of *L. hirsuta*: "*Female*. Length on slide 5 mm., length of wing 5 mm. Clypeus [frons] emarginate, the lateral processes very slightly exceeding the antennae. Ocellar triangle rather faintly defined, without median incision or emargination and with a small, median area of heavier chitinization. Orbits broad, with two large and numerous fine setae. Ventral side of the head with three conspicuously long setae near the base of the antenna. Thorax with the humeral calli very short and broad, but acutely pointed. In addition to the fixed setae, which are to be found in all the species of the genus, there are three long setae on each half of the prescutum and a pair of long prescutellars. Scutellum with a distinct median sulcus, which divides it into two lobes. Pleurotergite of the postscutellum distinctly swollen and bearing a cluster of setae which are concealed above the posterior coxa. Sternum with an undivided lobe between the anterior coxae. Legs with no specially distinctive characters, but rather noticeably sparsely haired. Wings entirely beset with setulae except for the area behind the anal vein. Subcosta complete, attaining the costa. Abdomen with two small tergal plates in addition to the usual basal and apical plates. The anterior lateral region shows a weakly defined plate on each side, this sparsely beset with setae, and the median dorsal area of transverse striations is almost devoid of setae. The membranous areas are beset with small slender setae which are borne upon slight tubercles and in the apical region on the ventral side there are numerous small, stout setae of which the supporting tubercles are noticeably larger. — *Male* closely resembling the ♀ but slightly smaller, length 4.5 mm., length of wing 4.5 mm. The external genitalia are represented merely by a pair of small flaps." Through the courtesy of Prof. G.F. Ferris, I was recently (1953) able to study the three types at Stanford University.

Lynchia holoptera (Lutz, Neiva and da Costa Lima)

Figs. 67*A–C*, 68 and 69

Olfersia holoptera Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 184 (no sex. Brazil: State of Rio de Janeiro, on *Rhynchotus r. rufescens* and *Aramides saracura*. Types at Inst. Osw. Cruz, Rio de Janeiro).

Lynchia holoptera J. Bequaert, 1943, Jl. of Parasitology, **29**, p. 134. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, pp. 410 and 425, figs. 252–253 (Wisconsin: Madison, Dane Co., on *Rallus l. limicola*).

Distribution and Specimens Examined. United States. Massachusetts: North Eastham, Barnstable Co., ♀ on *Rallus l. limicola* July 3 (F.C. Bishopp). — Ohio: South Bass I., Lake Erie, ♀ on *Rallus l. limicola* (W. Britt). — Pennsylvania: Linesville, Crawford Co., ♀ on a rail, May 15 (R.H. Fricke). — South Carolina: Mount Pleasant, Charleston Co., ♀ on *Coturnicops noveboracensis*, Nov. 8 (A.T. Wayne). — Wisconsin (recorded by MacArthur, 1948): Madison, Dane Co., ♀ on *Rallus l. limicola*, June 13 (J. Beer).

Brazil (recorded by Lutz, Neiva and da Costa Lima, 1915).

L. holoptera, known at present only from some of the eastern

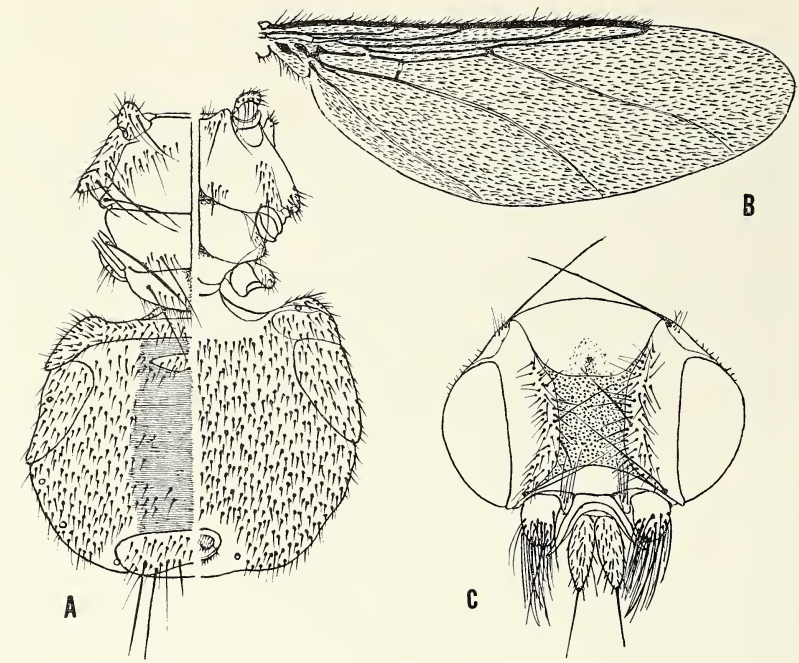

Fig. 67. *Lynchia holoptera* (Lutz, Neiva and da Costa Lima), ♀, North Eastham, Mass., on *Rallus l. limicola:* **A**, thorax and abdomen dorsally and ventrally; **B**, wing; **C**, head.

and central United States and from the State of Rio de Janeiro in Brazil, no doubt is widely distributed in the New World. Rails, its main hosts, are difficult to collect and their ectoparasites seldom obtained.

Known Hosts of *L. holoptera.* Tinamiformes: *Rhynchotus r. rufescens.* Gruiformes (4 and 1 unidentified rail) : *Aramides saracura; Coturnicops noveboracensis* (1) ; *Rallus l. limicola* (3).

Bionomics. Of the 7 host records known to date, 6 are from rails of three species, so that the Rallidae may safely be regarded as the true breeding hosts. The single record from a tinamou may have been due to straying or perhaps to *post mortem* contamination; although tinamous and rails are ground birds of somewhat similar habits, so that they could possibly harbor the same louse-fly. The puparium is unknown.

Affinities. *L. holoptera* is easily recognized by the characters given in the key and by the figures. The ♂ is as yet unknown. The

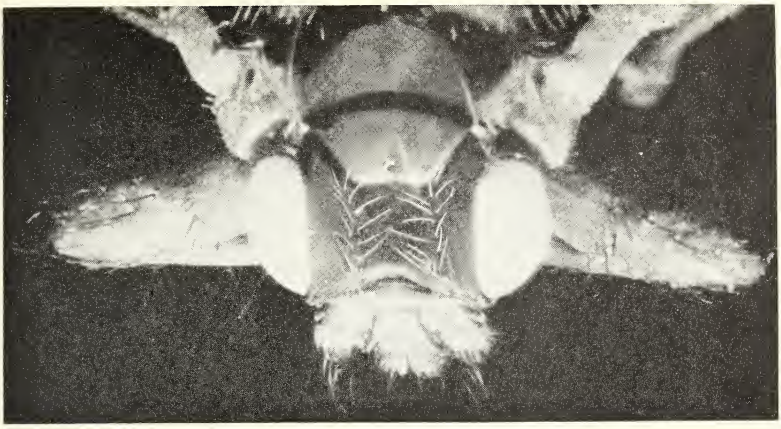

Fig. 68. *Lynchia holoptera* (Lutz, Neiva and da Costa Lima), head, ♀, Madison, Wisc., on *Rallus l. limicola*. Photograph by Mr. K. MacArthur (1948, fig. 253).

material seen is too scant for a study of variation. In the few flies available the subcosta is complete in both wings (Figs. 67*B* and 69), as noted in the original description; it usually ends about opposite the anterior basal cross-vein or slightly basad. The 2nd basal cell is relatively long and narrow, about half the length of the 1st basal cell or slightly shorter. The anterior cross-vein is very short and thick. The microtrichia cover practically the entire membrane, except for a very narrow bare strip along the lower (outer) margin of the postaxillary cell. The wing is 4.6 to 5 mm. long. The postvertex is unusually long, only about twice as wide as long; its anterior half is broadly depressed medially, with a weak median pit a short distance from the margin. There is usually only 1 vertical bristle; but the ♀ from North Eastham, N.H., has 2 bristles on the right and 1 bristle on the left outside the corners of the postvertex. The abdomen has one median sclerite differentiated in the striolate dorsal area close behind the fused basal laterotergites (sometimes partly hidden by contraction under their hind edge); the 3rd laterotergite (bearing the 3rd abdominal spiracle) is better differentiated and more sclerotized, both dorsally and ventrally, than in most other *Lynchia*. There is no raised setigerous knob ventrally between the 7th abdominal spiracle and the ano-genital openings. The fly is more setose than usual, particularly on the legs, the femora and tibiae bearing, in addition to fairly numerous long bristles, many short setae, though not as many as in *L. albipennis*.

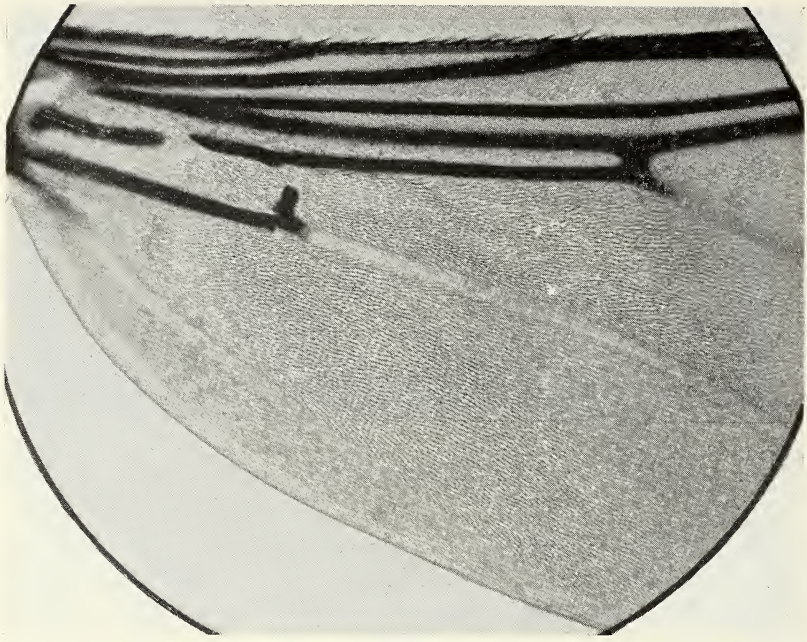

Fig. 69. *Lynchia holoptera* (Lutz, Neiva and da Costa Lima), basal area of wing, ♀, Madison, Wisc., on *Rallus l. limicola*. Photograph by Mr. K. MacArthur (1948, fig. 252).

Original description of *O. holoptera* (translated from the Portuguese): "Length 5 mm.; of wing 5 mm. General color chocolate; wings without bare area. Palpi ochraceous, covered with pruinosity and with blackish hairs. Antennae chestnut, the terminal portion with yellowish-white pruinosity and black hairs; basal process with yellowish pruinosity and bristles; clypeal process forming a slightly acute, almost right angle; its anterior face with yellowish-white pruinosity and its upper face shiny pale-chestnut; ocular margins [inner orbits] broad, dark-chestnut, shiny with a large dull depression over the median third of the inner margin; vertical triangle [postvertex] rounded, pale-chestnut, but infuscated medially; occipital margin convex behind, the anterior margin [of postvertex] with a small submarginal pit within a rather large median depression; middle part of frons [interocular face] black, finely striate, somewhat shiny, the bristles as in *O. palustris* [*Lynchia albipennis* Say]; space behind the eyes dull and whitish; under side of head ochraceous. Mesonotum black, with a bronzy gloss and some golden-yellow hairs; humeral callosities large, the color of tortoise, with a white spiracular spot; adjoining areas ochraceous-gray; posterior margin, from the base of the wings on, without gloss, widened before the scutellum into halfmoon-shaped lateral spots with the surface ashy and granulose, the median area between these spots shiny; in the middle of the spots one dark bristle and 5 other larger bristles on each side of the dorsal margin of the thorax; median notal suture narrow but deep behind the transverse suture, margined with reddish anteriorly; transverse mesonotal suture deep, effaced near the middle. Scutellum halfmoon-shaped, with rather large median, dull furrow, the remainder as on the

mesonotum, only the anterior margin yellowish and the ciliae darker. Abdomen gray, more or less infuscate, with numerous black ciliae and on the posterolateral areas with larger bristles. Legs ochraceous-gray, as is also the thorax beneath; the surface finely granulose and shiny. Wings rather pale, but without bare part; veins chestnut or infuscate; auxiliary vein [subcosta] ending in costa a little before inner [anterior basal] cross-vein.'' I have not seen the types.

Lynchia plaumanni J. Bequaert

Figs. 70*A–H*

Lynchia plaumanni J. Bequaert, 1943, Jl. of Parasitology, **29**, p. 132, figs. 1*A–E* (♀ ♂. Brazil: Nova Teutonia near Ita, 27° 11′ S., 52° 23′ W., State of Sa. Catharina, ♀ holotype, ♂ allotype, and ♀ ♂ paratypes on *Odontophorus c. capueira;* ♀ paratypes on *Crypturellus o. obsoletus* and *Chamaeza c. campanisona* [''*Turdus brevicauda*'']. British Guiana: Paruni River, ♀ paratype on *Crax nigra.* Bolivia: Sa. Elena, Huachi, Río Beni, ♂ paratype. Holotype and allotype at Mus.Comp.Zool., Cambridge, Mass.; paratypes at Deutsch.Entom.Inst., Berlin-Dahlem, U.S.Nat.Mus. and Brit.Mus.).

Ornithophila sp. Aldrich, 1923, Insecutor Inscitiae Menstruus, **11**, p. 78 (Bolivia: Sa. Elena).

Distribution and Specimens Examined. Mexico: Laguna Ocotal, State of Chiapas, ♀ on *Ortalis v. vetula* and ♀ caught flying (R.A. Paynter, Jr.).

British Guiana: Paruni River, ♀ paratype on *Crax nigra* (Brit. Mus.).

Brazil: Nova Teutonia near Itá, State of Sa. Catharina, ♀ holotype, ♂ allotype, and ♀♂ paratypes on *Odontophorus c. capueira,* and ♀ paratypes on *Crypturellus o. obsoletus* and *Chamaeza c. campanisona* (F. Plaumann. — Mus.Comp.Zool., No. 29433; Deutsch. Entom.Inst.).

Bolivia (recorded by Aldrich, 1923, as *Ornithophila* sp.): Sa. Elena, Huachi, Río Beni, ♂ paratype (W.M. Mann. — U.S.Nat. Mus.).

Known Hosts of *L. plaumanni.* Tinamiformes (1): *Crypturellus o. obsoletus* (1). Galliformes (3): *Crax nigra* (1); *Odontophorus c. capueira* (1); *Ortalis v. vetula* (1). Passeriformes (1): *Chamaeza c. campanisona* (1).

Bionomics. Nothing definite can be said at present about the true breeding hosts of *L. plaumanni,* the known host records being too few. Other details of the life history are unknown.

Revised Description. *Female.* Head (Fig. 70*C*) in front view about $1\frac{1}{6}$ times as wide across eyes as high from occipital margin to tips of apical arms of frons. Interocular face at its narrowest about $1\frac{2}{3}$ times as wide as an eye, scarcely longer along inner orbit than its greatest width at postvertex, the sides converging toward

lower third. Inner orbits moderately wide, about $\frac{1}{3}$ of width of mediovertex at its narrowest; inner orbital bristles few: a lower group of 4 (3 very long) near lunula and a row of 3 to 5 (1 very long) at about mid-height of face; one long vertical bristle on each side. Postvertex wider than long, the nearly straight or slightly wavy anterior margin longer than the sides, with one or more rudimentary ocelli or with pits taking their place (Figs. 70*C* and *E–F*): some flies have only 3 pits without ocelli, either partly connected or fused into a single horseshoe-shaped depression; in others the pits show rudimentary ocelli, rarely in the anterior pit, more often in the other 2; these ocelli are usually very small and flat, but in one fly they are well defined and convex in all 3 pits; it is doubtful nevertheless that the ocelli are ever functional. Frons: lunula separated from the interantennal area by a complete transverse suture, with or without shallow median depression; basal, undivided portion of interantennal area narrower than its distance from inner eye margin; apical emargination very deep, moderately wide, with very long, narrow prong-like terminal arms, extending beyond tips of antennae. Antenna short: 1st segment separated by a complete suture from lunula, bearing 2 or 3 setae, one long; 2nd segment about twice as long as 1st along inner margin, rounded truncate at apex, moderately setose over apical dorsal half, with 5 or 6 long, recurved bristles. Palpi moderately long, nearly half the height of head. Thorax (Fig. 70*A*): anterior dorsal margin nearly straight in the middle; humeral callosities slightly longer than wide, moderately prominent, bluntly rounded at apex, with one long bristle and many shorter setae. Mesonotum on each side with 2 transverse patches of short setae, one behind the humeral callosity, the other before the scutellum; a longer bristle in the prescutellar patch; a long notopleural and a long postalar bristle on each side; dorsal portion of mesopleuron (anepisternum) with scattered short setae and one long bristle some distance from apex. Scutellum semi-elliptical; hind margin evenly convex, lower edge fringed with soft setulae; a preapical row of fine short setae; one long outer discoscutellar bristle on each side. Pleurotergite with a few short, stiff setae. No metasternal spurs near hind coxae. Legs: femora and tibiae with several strong bristles and sparse short setae; 4th tarsal segment of fore legs normal. Wing (Fig. 70*D*) short, relatively wide; microtrichia covering most of membrane, except for a small posterior bare area in basal $\frac{1}{2}$ to $\frac{2}{3}$ of combined anal, 3rd posterior and axillary cells and nearly entirely bare postaxillary cell; costa moderately swollen beyond tip of 1st longitudinal vein; 2nd basal cell slightly

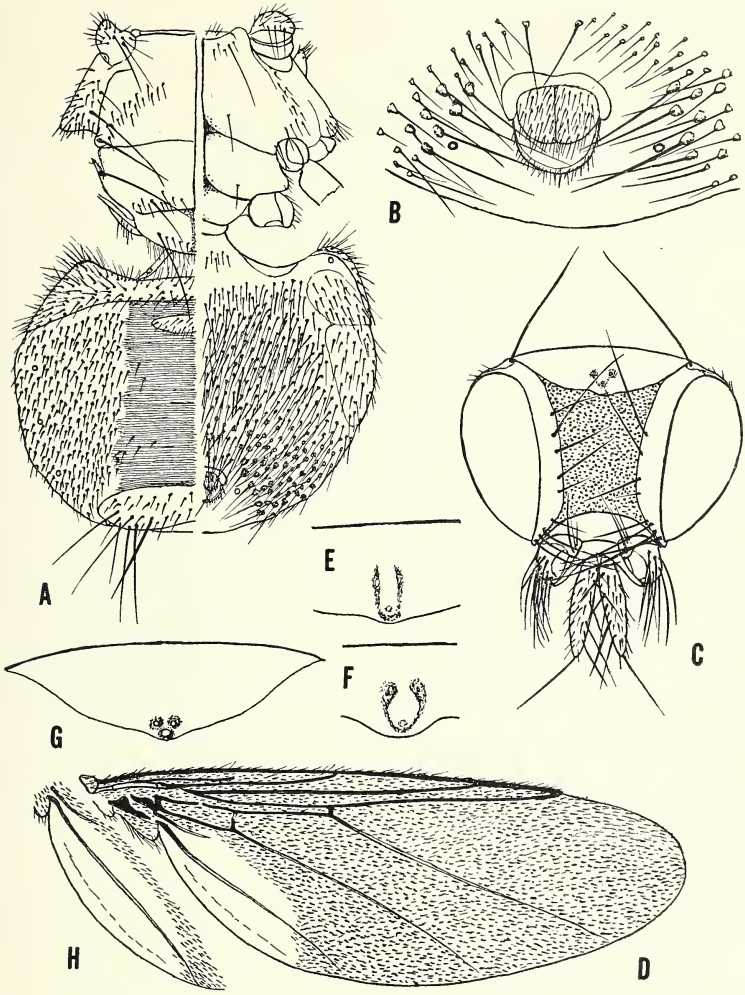

Fig. 70. *Lynchia plaumanni* J. Bequaert. **A–D**, ♀ holotype, Nova Teutonia, Brazil, on *Odontophorus c. capueira:* **A**, thorax and abdomen dorsally and ventrally; **B**, ventral anal area of abdomen; **C**, head; **D**, wing; **E** and **F**, ocellar area of 2 ♀ paratypes, Nova Teutonia, on *Chamaeza c. campanisona;* **G**, postvertex with rudimentary ocelli, ♂ allotype, Nova Teutonia, on *Odontophorus c. capueira;* **H**, axillary vein and postaxillary cell, ♂ allotype, same data.

less than half as long as 1st; anterior basal cross-vein nearly vertical; subcosta incomplete, not reaching costa (in all 9 flies examined), usually stopping in the membrane nearly opposite or basad of anterior basal cross-vein; stump of 6th longitudinal vein distinct, short. Abdomen (Fig. 70*A–B*) dorsally: a broad, short, transversely lozenge-shaped basal sclerite (fused 1st and 2nd laterotergites), bearing short, stiff setae at the sides and softer ones in the middle; large preänal tergite transverse, reniform, with a few short setae and an apical group of 7 or 8 long, stiff bristles at each side; middle of dorsum extensively dull, microscopically cross-striate, almost bare, with a small, smooth, median tergite behind and close to the fused basal laterotergites; sides of dorsum soft, uniformly and fairly densely covered with short setae; ventrally, 2 broad areas more or less defined at each side over basal half, sometimes partly sclerotized, the hindmost with an evenly, broadly rounded hind margin; venter fairly uniformly and densely setulose, the setae longer than usual, arising on the postero-lateral areas from strong, conical tubercles (Fig. 70*B*); no setulose raised knob between the 7th abdominal spiracle and the ano-genital openings ventrally.

Male. Similar to the ♀, even in the relative width of the interocular face and the sclerites of the abdomen; preänal dorsal sclerite of the same shape; but sides of basal laterotergites strongly produced behind as triangular lobes. Setigerous lobes at sides of genital atrium small. In the paratype the postvertex has 3 distinct ocellar pits (Fig. 70*G*), the anterior one bearing a large, flattened ocellus, the 2 posterior ones each with a very small, rudimentary ocellus.

Length (of both sexes) from tips of apical arms of frons to hind margin of scutellum, 2.7 mm.; of wing, 5.5 to 6.2 mm. long (6 mm. in ♀ holotype, 5.5 mm. in ♂ allotype); width of wing, 2 to 2.2 mm.; total length of dry holotype, slightly over 4 mm.

Affinities. *L. plaumanni* differs from most of its congeners in the presence of distinct ocellar pits or of rudimentary ocelli, traced in all known specimens, but varying as described above. In every other respect, however, it is a true *Lynchia,* so that I do not attach undue importance to this feature, although it appears to be a valid specific character. Moreover, as noted in the generic discussion, distinct ocellar pits or vestigial ocelli are present in a few other members of the genus, in some cases even more marked. The best known of these ocelligerous species is *Lynchia maquilingensis* Ferris (1924*a*, p. 392), of the Malay Archipelago. A study of the holotype at the U.S.Nat.Mus. and of the description and original figures shows that *maquilingensis* differs from *plaumanni* in several characters,

particularly in the extent of the microtrichia of the wing, which cover most of the membrane, leaving only a very narrow postero-marginal bare strip in the postaxillary cell (see Ferris, 1924*a*, p. 594, fig. 2*a*).

Original description of *L. plaumanni:* "*Female.* Head seen in front about $1\frac{1}{3}$ times as wide as high; frons at its narrowest about $1\frac{2}{3}$ times as wide as eye, measured along inner orbits scarcely longer than its greatest width at vertex, with sides markedly convergent toward lower third; inner orbits (parafrontalia) moderately wide, about $\frac{1}{3}$ of width of mediovertex (frontalia) at its narrowest; frontal bristles few: a lower group of 4 (3 very long) on gena and median row of 3 to 5 (1 very long) near edge of mediovertex; 1 very long vertical bristle; postvertex (vertical triangle) much wider than long, the nearly straight or slightly wavy anterior margin longer than the sides, with one or more rudimentary ocelli or depressions taking their place, as described below; fronto-clypeus broadly and rather shallowly emarginate medially, the antero-lateral angles moderately produced. Palpi moderately long, nearly half height of head. Thorax of usual shape; anterior margin nearly straight in the middle; humeral lobes slightly longer than wide, moderately prominent, bluntly rounded at apex, with 1 very long bristle and many shorter setae. Mesonotum on each side with 2 transverse patches of short setae, behind humeral lobe and before scutellum; a longer seta in prescutellar patch; a very long preälar and a similar postalar bristle on each side; dorsal portion of mesopleura (notopleura) with scattered short setae and 1 very long bristle near posterior corner. Scutellum semi-elliptical, hind margin evenly convex, fringed at edge with soft hairs and before this with a row of fine short bristles; 1 long scutellar bristle in each corner; metepimeron with a few, short setae. Legs without distinctive features; 4th tarsal segment of fore legs normal. Wing rather short and broad; microtrichia covering the membrane except for small basal area in anal cell (Cu + 1st An) and most of axillary cell (2nd An); costa moderately swollen beyond tip of 1st longitudinal vein; 1st basal cell (R) very long, narrow, parallel-sided; 2nd basal cell (M) slightly less than half length of 1st, closed by nearly vertical anterior basal cross-vein (M_3); subcosta (Sc) incomplete, not reaching costa; costa and basicosta densely setulose; all other veins bare. Abdomen with usual broad, short, transversely lozenge-shaped basal, sclerotized tergite, bearing numerous short, stiff setae on sides and soft hairs in middle; preänal (dorsal) sclerite transverse, large, reniform, bearing few short setae and in each apical corner 7 or 8 very long, stiff bristles; remainder of dorsum forming one sclerotized area, without differentiated tergites, dull, microscopically cross-striate, almost without pilosity; sides and venter soft, uniformly and fairly densely covered with short setae; ventrally, 2 broad sclerites more or less defined on each side over basal half, hind margin of 2nd evenly and broadly rounded off. — *Male.* Extremely similar to ♀, even in width of frons and structure of abdomen; preänal sclerite has same shape; but basal sclerotized tergite is produced at sides into triangular lobes. — Length (of both sexes) from tip of fronto-clypeus to apex of scutellum, 2.7 mm.; of wing, 5.5 mm.; width of wing, 2mm. (total length of dry specimen, slightly over 4 mm.). — An unusual feature of *L. plaumanni* is the presence of either rudimentary ocelli or ocellar pits, which could be traced in all 9 specimens. Their development varies. There may be only 3 pits in which no true ocelli can be seen, the pits being often more or less connected or sometimes forming one horseshoe-shaped depression. The anterior ocellus can rarely be detected, but the 2 posterior ocelli are often outlined, though small and flat." This description has only a historical interest. The revised account, given above, should be used for a study of the species.

Microlynchia Lutz, Neiva and da Costa Lima, 1915

Microlynchia Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, 7, pp. 177 and 185 (monotypic for *Lynchia pusilla* Speiser, 1902).

Generic Characters. Fully-winged parasites of birds, of small size (wing 3.5 to 6.5 mm. long), agreeing with *Lynchia*, except as noted here. Integument of head and thorax not metallic-greenish, sometimes with whitish, enamel-like areas; haemolymph without dull-greenish pigment. Vestigial ocelli more or less developed, minute, variable in size and shape even in the same species, occasionally lacking, possibly never functional. Lunula and interantennal portion of frons either separated by a superficial suture or completely fused; undivided base of interantennal area ending in two flaring apical arms varying in length. Antenna short: 1st segment setulose, either completely or partly separated by a superficial suture from the lunula, or fused with it; 2nd segment and arista as in *Lynchia* and *Pseudolynchia*. Dorsum of thorax as in most small species of *Lynchia* (such as *L. albipennis*); notopleuron fused with prescutum, but the limit between them sometimes faintly indicated by a depression, its hind corner well set off as a short lobe bearing a single, notopleural bristle. Transverse mesonotal suture continuous, deep and wide. Scutellum relatively longer than in most *Lynchia*, more transversely elliptical, the deep scutoscutellar suture evenly and slightly arched forward, the hind margin nearly straight, the slanting sides with evenly rounded hind angles, lacking the setigerous digitations of *Pseudolynchia;* usually one long discoscutellar bristle in each corner (exceptionally 2 or 3 bristles); other preäpical setae few and soft; thick, obtuse hind margin with a lower fringe of soft setulae; surface smooth, without median rugulose depression or line. Metathoracic pleurotergite more prominent than in *Lynchia* and *Pseudolynchia*, the apical (upper) part set off as a broad, blunt, setigerous knob or cone. Sternum: prosternum forming 2 broad, raised lobes between fore coxae, similar to those of *Pseudolynchia,* but lower, the notch between them being shallower; meta-basisternum more prominent laterally than in most *Lynchia*, the outer margin a broad, rounded lobe, but without the metasternal spur which overlaps the hind coxa in *Pseudolynchia* and a few species of *Lynchia;* basisternum and furcasternum of metathorax separated by a distinct suture; meta-furcasternum diamond-shaped, produced behind in a blunt point and set off by slight depressions from hind coxae; median sternal suture continued over meta-furcasternum. Prothoracic and metathoracic spiracles as in *Lynchia.*

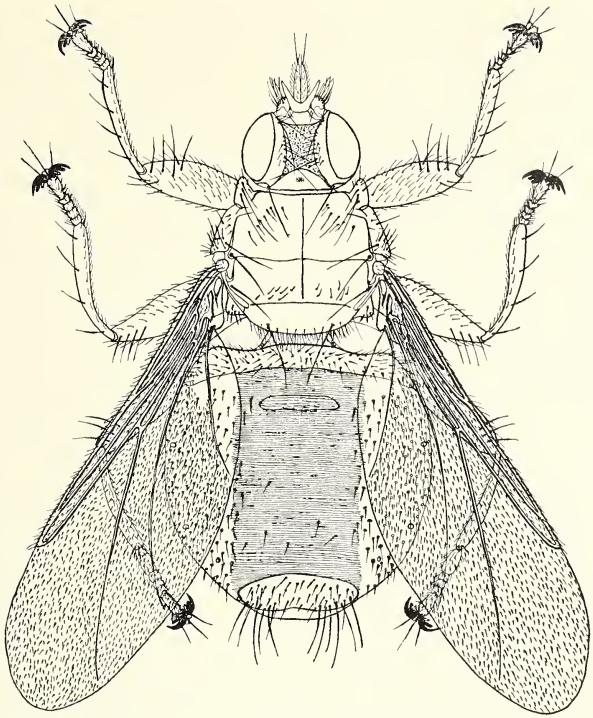

Fig. 71. *Microlynchia pusilla* (Speiser), ♀, Clayberg Co., Tex., on *Geococcyx californianus.* × about 15.

Legs and claws (Fig. 73*B*) as in *Lynchia,* but empodium simple, not feathered. Wing (Figs. 73*A*, 74*B*, 75*A* and 76*A*) large, with the reduced venation of *Pseudolynchia,* without posterior basal and anterior basal cross-veins; 6th longitudinal vein reduced to a basal stump (as explained for *Lynchia*); subcosta either complete or incomplete, even in the same species; 2nd longitudinal vein mostly free from costa, ending a short distance basad of tip of 3rd longitudinal; membrane extensively covered with microtrichia; alula very narrow; calypteres as in *Lynchia.* Abdomen as in *Lynchia;* dorsally with an extensive median striolate area, in which only one median sclerite is differentiated; the sclerite also shows some transverse striae, which are farther apart than those of the surrounding striolate area; in the ♀ it is short and narrow and lies close behind the fused basal laterotergites; in the ♂ it is a short but (transversely) wide strip behind mid-length, basad of the large preäpical

dorsal sclerite. Chaetotaxy less developed than in *Pseudolynchia*, more as in most *Lynchia;* ♀ without soft, setigerous knob ventrally between 7th abdominal spiracle and ano-genital openings. Seven pairs of abdominal spiracles, placed as in *Lynchia*. Male terminalia (Fig. 72*C*), as in *Lynchia* and *Pseudolynchia:* gonocoxites rudimentary; instead a setigerous lobe (*slo*) at each side of genital atrium.

In general *Microlynchia* agrees with *Pseudolynchia* and *Lynchia*, as mentioned before; but it retains more of the characteristics of *Lynchia* than does *Pseudolynchia*. The scutellum is as in *Lynchia*, lacking the setigerous digitations at the corners; but its surface is smooth and even. The meta-furcasternum is not emarginate, but pointed behind, with a distinct longitudinal median suture. The outer margins of the meta-basisternum form no metasternal spurs near the hind coxae. The metathoracic pleurotergite is much more prominent than in either *Lynchia* or *Pseudolynchia*. The venation is essentially that of *Pseudolynchia;* but the 2nd longitudinal vein ends close to the tip of the 3rd longitudinal and its apical portion is not or only very briefly fused with the costa. The pilosity is much sparser on head and thorax than in *Pseudolynchia*. These peculiarities would seem to justify retaining *Lynchia, Microlynchia* and *Pseudolynchia* as distinct genera in spite of their obvious relationship. I do not attach undue importance to the presence or lack of ocelli, as these organs are unstable in several Hippoboscidae, being evidently at present in the process of disappearing in certain genera. The matter was discussed at some length under *Lynchia*.

I now regard *Microlynchia* as restricted to the New World and recognize four species. *M. furtiva* and *M. galapagoensis*, here described as new from a few specimens, appear to be very distinct. The other two, *M. pusilla* and *M. crypturelli*, are extremely similar and it is even possible that they might be cospecific. However, it seems premature to lump them at present, in view of the limited amount of hippoboscid material thus far available from tinamous, possibly the only true breeding hosts of *crypturelli*.

In an earlier paper (1938*b*, p. 349), I referred doubtfully to *Microlynchia* the Old World *Olfersia falcinelli* Rondani (1879, p. 23), described from an unknown host at Malta. According to Dr. B. Lanza (*in litt.*, 1953), the type is now in Rondani's collection at the Florence Museum. I have not seen it; but from the description it could scarcely have been a *Microlynchia* and was most probably a small species of *Lynchia*. I now suspect that it is the very small species of *Lynchia* which I have seen from a variety of Passeriformes

in Africa, Asia Minor and southern Europe, and of which a specimen was recently obtained in the British Isles. This parasite will be discussed fully elsewhere.

Key to Species of *Microlynchia*

1. Wing membrane without microtrichia over entire postaxillary cell and hind third of combined anal, 3rd posterior and axillary cells. Lunula and interantennal area of frons fused; interantennal area as wide as its shortest distance from an eye; apical arms short, not prong-like. Orbital bristles few, in one row. Palpi only slightly shorter than height of eye or than mediovertex. Metathoracic pleurotergite very prominent. Wing 4.5 to 4.8 mm. long ..... *M. galapagoensis*

   Only nearly entire postaxillary cell of wing membrane without microtrichia. Metathoracic pleurotergite low 2

2. Palpi longer than height of eye or of combined mediovertex and postvertex. Lunula and interantennal area of frons fused; interantennal area flat, long, wider than its shortest distance from an eye; apical arms short, very wide, not prong-like. Orbital bristles few, in one row. Wing 6.4 mm. long. *M. furtiva*

   Palpi shorter than the height of an eye or of the combined mediovertex and postvertex. Lunula and interantennal area of frons separated by a distinct or weak suture; interantennal area short, at most as wide as its shortest distance from an eye; apical arms long, narrow, prong-like. Orbital bristles fairly many, not all in one row 3

3. Interantennal area of frons at least as wide as an antennal pit, little or not depressed lengthwise; apical arms moderately long, rather strongly diverging and distinctly widened basally. Wing 3.8 to 4.5 mm. long ..... *M. pusilla*

   Interantennal area of frons narrower than an antennal pit, usually with a deep longitudinal groove; apical arms very long, moderately diverging and about equally wide throughout. Wing 4.5 to 5.3 mm. long ..... *M. crypturelli*

Microlynchia pusilla (Speiser)

Figs. 3*A–C*, 71, 72*A–F* and 73*A–F*

Lynchia pusilla Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 157 (no sex; no host. Cuba. Type at Berlin Mus.). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Herms, 1923, Medical Veterinary Entomology, 2nd Ed., p. 351.

Microlynchia pusilla Ad. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 185; Pl. 27, fig. 2; Pl. 28, fig. 6 (Brazil: States of Rio de Janeiro, Minas Gerais and Espirito Santo; on *Columbigallina t. talpacoti, Leptotila rufaxilla* [=*L. r. reichenbachii*], and *Scardafella "squamosa"* [=*S. squamata squamata*]). de Beaurepaire Aragão, 1916, Brazil-Medico **30**, p. 353 (supposed transmission of *Haemoproteus columbae* in Brazil). Lavier, 1921, Parasites Invertébrés Hématophages, p. 108. Ad. Lutz and Nuñes-Továr, 1928, Estudios Zoología Parasitología Venezolanas, p. 9 (Venezuela, on pigeons). Ferris, 1930, Canad. Entom., **62**, p. 66, figs. 3 and 4*A–E* (♀. Arizona: Thatcher, on domestic pigeon). J. Bequaert, 1933, Proc. California Ac. Sci., (4), **21**, pt. 11, p. 135; 1938, Revista de Entomologia, Rio de Janeiro, **9**, p. 345, fig. 3 (♀ ♂). Root and Huff, 1938, Parasitology Man Domestic Animals, p. 614. Carbonell, 1938, Parasitología en Venezuela y los Trabajos del Dr. M. Nuñez-Továr, p. 250. Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 983. Thompson, 1938, Ent. Mo. Mag., **74**, p. 46. Brennan, 1938, Science, **88**, p. 571 (Texas: San Antonio and Uvalde, on *Zenaidura macroura carolinensis*). Martorell, 1939, Jl. Agric. Univ. Puerto Rico, **23**, p. 221. Huff, 1939, Jl. Amer. Vet. Med. Assoc., **94**, p. 619. J. Bequaert, 1939, Science, **89**, p. 267; 1940, Mem. Soc. Cubana Hist. Nat., **14**, pt. 4, p. 325. Coatney and West, 1940, Amer. Jl. Hyg., **31**, pt. 1, Sect. *C*, p. 12. J. Bequaert, 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, pt. 11, p. 287. McClure, 1941, Iowa State Coll. Jl. Sci., **16**, p. 95 (Iowa: on *Zenaidura macroura carolinensis*); 1943, Bull. No. **310** Iowa Agric. Expt. Sta., p. 406 (Iowa: Cass Co., on only 7 of 1700 young *Zenaidura macroura carolinensis*, none on adult birds). J. Bequaert, 1943, Bol. Entom. Venezolana, **1**, pt. 4, p. 82. Neveu-Lemaire, 1943, Traité Protozoologie Médicale Vétérinaire, pp. 451 and 795. Herman, 1945, California Fish Game, **31**, p. 22 (California: Brawley, on *Zenaidura macroura marginella*). Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 154 (St. Croix: on *Columbigallina passerina nigrirostris*). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Herms, 1950, Medical Zoology, 4th Ed., p. 414. J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, pt. 1, (for 1950), p. 9. Schuurmans Stekhoven, 1952, Beiträge zur Fauna Perus, **3**, Wissensch. Bearbeit., pp. 92 and 101 (Peru: Hacienda Huayuri, in pigeon nests). Parmalee, 1952, Trans. 17th North American Wildlife Conf., p. 180 (Texas: Brazos Co. and Robertson Co., on *Colinus v. virginianus;* Robertson Co., on *Richmondena c. cardinalis* and *Toxostoma r. rufum*). Parmalee and Price, 1953, Jl. of Parasitology, **39**, p. 222 (Texas: in the Post Oak region, on *Colinus v. virginianus*). Parmalee, Hightower, Lehman and Eads, 1953, Jl. of Mammology, **34**, p. 269 (Texas: Kleberg Co., on *Colinus v. virginianus, Mimus p. polyglottos* and *Geococcyx californianus*). Campbell and Lee, 1953, Studies on Quail Malaria, New Mexico Dept. Fish Game, pp. 52 and 70 (New Mexico: San Miguel Co., on *Callipepla squamata pallida*); 1953, Completion Report, New Mexico Project W-41-R, (mimeographed), p. 3.

Pseudolynchia maura Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 154 (St. Croix: on *Columbigallina passerina nigrirostris*). Not of Bigot, 1885.

Distribution and Specimens Examined. United States. Arizona (recorded by Ferris, 1930): without precise locality on *Callipepla squamata pallida;* Phoenix, Maricopa Co., on *Pipilo a. aberti, Lophortyx g. gambelii, Molothrus ater obscurus, Zenaidura macro-*

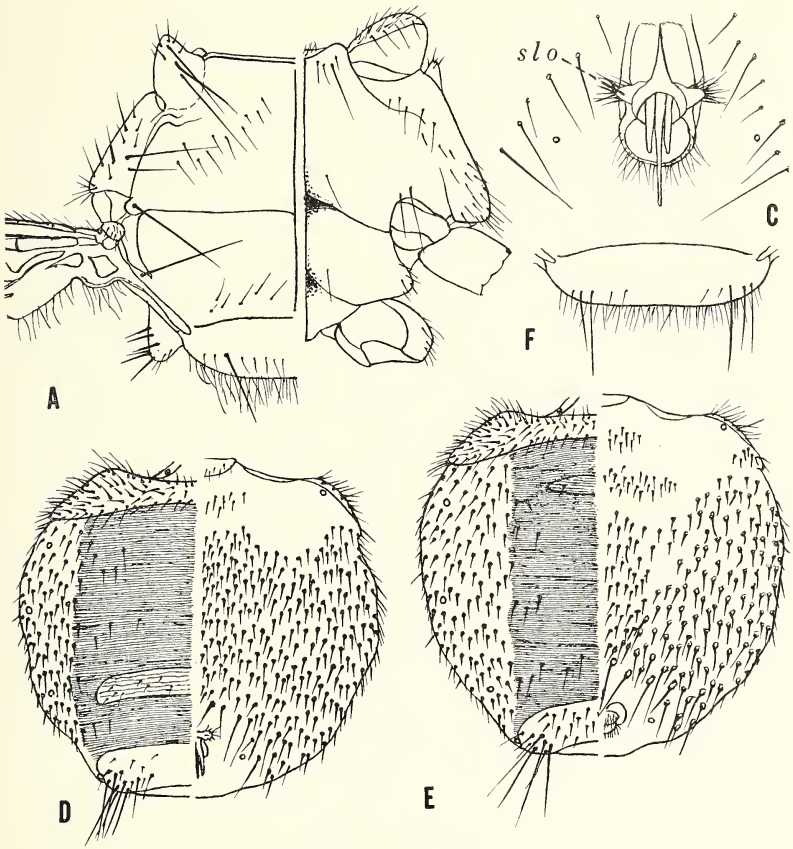

Fig. 72. *Microlynchia pusilla* (Speiser). **A,** thorax dorsally and ventrally, and base of left wing, ♀, Bexar Co., Tex., on *Zenaidura macroura carolinensis;* **F,** scutellum, ♀, St. Thomas, on *Oreopeleia mystacea beattyi;* **C,** ♂ terminalia, Conchas Dam, N. Mex., on *Callipepla squamata pallida: slo,* setigerous lobe at side of genital atrium; **D,** abdomen dorsally and ventrally, ♂, Conchas Dam, on *C. s. pallida;* **E,** abdomen dorsally and ventrally, ♀, Sabinal, Tex., on *Geococcyx californianus.*

ura marginella (C. Stannard); Baboquivari Mts., Pima Co., (E.I. Ball); Benson, Cochise Co., on *Scardafella inca* (E.R. Tinkham); 10 miles E. of Yuma, Yuma Co., on 2 *Pipilo a. aberti* (D.P. Furman and D. J. Gould); Thatcher, Graham Co., on domestic squabs, Sept. 15. — California (recorded by Herman, 1945): Coachella, Riverside Co., on *Mimus polyglottos leucopterus,* Jan. 19, *Geococcyx californianus,* and *Pipilo a. aberti,* June 16 (Mrs. B.L. Clary); Brawley, Imperial Co., on *Zenaidura macroura marginella,* Apr. 7 (G. Augustson); Calipatria, Imperial Co., on *Pipilo aberti dumeticolus,* Feb. 21 (J.N. Belkin); Shandon, San Luis Obispo Co., on *Zenaidura macroura marginella,* 1 ♂, Sept. 18 (I.B. Tarshis); Pasadena, Los Angeles Co., on *Streptopelia c. chinensis* (Mrs. Josephine R. Michener) and on *Hedymeles m. melanocephalus* (H. and J. Michener).—District of Columbia: on *Geococcyx californianus* in the Zoological Garden; in a market on dead *Callipepla squamata pallida* imported from Arizona. — Florida: Homestead, Dade Co., on *Zenaidura macroura carolinensis,* Sept. 23 (W.W. Wirth). — Idaho: Carey, Blaine Co., Sept. 1, on *Zenaidura macroura marginella* (R. Matheson). — Iowa (recorded by McClure, 1941): Lewis, Cass Co., on *Zenaidura macroura carolinensis* (H.E. McClure). — Kansas: Lawrence, Douglas Co., on domestic pigeon (R.H. Beamer).—Nebraska (recorded by Swenk, in Bequaert, 1938): Lincoln, Lancaster Co., Apr. 20, on *Zenaidura macroura marginella,* ♀ with 2 Mallophaga on left side of dorsum of abdomen (C.E. Mickel and Dawson).—New Mexico (recorded by Campbell and Lee, 1953): Conchas Dam, San Miguel Co., on *Callipepla squamata pallida,* Dec. 7 (L. Lee, through D.P. Furman). — North Dakota: Fargo, Cass Co., on *Mimus polyglottos leucopterus* (D.A. Stevens). — Texas (recorded by Brennan, 1938): Brownsville, Cameron Co., Aug. 2, on *Zenaida a. asiatica;* Raymondville, Willacy Co., on *Sturnella m. magna,* Apr. 20 (E.F. Knipling); 4 miles E. of Benchley, Robertson Co., on *Toxostoma r. rufum,* Nov. 26, *Richmondena c. cardinalis,* Nov. 24, and *Colinus v. virginianus* (M.A. Price); 8 miles E. of Bryan, Brazos Co., on *Colinus v. virginianus* (M.A. Price); Kleberg Co., Jan. 9–12 and Feb. 13, on *Geococcyx californianus, Mimus p. polyglottos,* and *Colinus v. virginianus* (B.G. Hightower); Sonora, Sutton Co., without host, Sept 21 (O.G. Babcock), and on *Pipilo fuscus mesoleucus,* Jan. 23 (F.C. Bishopp); Sabinal, Uvalde, Co., on *Geococcyx californianus,* Dec. 29 (F.C. Pratt); Menard Co., on *Geococcyx californianus,* Sept. 8 (F.C. Bishopp); San Antonio, Bexar Co., on *Zenaidura macroura carolinensis,* Sept. 12 (J.M. Brennan) and on domestic pigeon (B. Weir); Corpus Christi, Nueces Co., on *Geococcyx californianus,*

March 15 (G.K. Cherrie) and *Richmondena c. cardinalis*, July 22 (F. Harper); Whitecotton Ranch, Zavala Co., on *Geococcyx californianus* and *Toxostoma c. curvirostre* (C.W. Johnson and O.L. Walker), and on *Molothrus ater obscurus* and *Arremonops rufivirgatus* (B.G. Hightower); Uvalde, Uvalde Co., without host, Dec. 29, on sparrow hawk, March 8 (F.C. Bishopp and D.C. Parman), and on *Zenaidura macroura carolinensis*, Oct. 21 (W.L. Barrett, Jr. and R.W. Burgess); Dallas, Dallas Co., on *Geococcyx californianus*, Sept. 2 (F.C. Bishopp); Sheffield, Pecos Co., on *Callipepla squamata pallida*, Jan. 24 (H.S. Peters); [Camp Bullis near San Antonio, on *Caprimulgus carolinensis*, *Mimus polyglottos leucopterus*, *Richmondena c. cardinalis*, and *Colinus v. virginianus*. — J. M. Brennan, *in litt.*, 1945; not seen].

Mexico: San José del Cabo, Baja California, on *Zenaida asiatica mearnsi*, Feb. 17 (G.F. Augustson); Xocempich, 10 miles from Chichen Itza, Yucatan (D.B. Legters); near Granados, State Sonora, 1 ♀ and 1 ♂ on *Toxostoma d. dorsale*, Nov. 21 (A.R. Phillips); Clarion I., Revilla Gigedo Group (Pacific Ocean), 1 ♀ on *Zenaidura macroura clarionensis*, May 7–8 (W.A. McDonald and Blodget).

Costa Rica: Turrialba, on wild pigeon [probably *Columba rufina pallidicrissa*] and *Arremonops striaticeps* (K.W. Cooper).

Antilles. Cuba (recorded by Speiser, 1902). — St. Croix (recorded by Beatty, 1947): on *Columbigallina passerina nigrirostris* (H.A. Beatty. — Specimens recorded by error as *Pseudolynchia maura* by Beatty, 1947) and *Oreopeleia mystacea beattyi* (H.A. Beatty; G.A. Seaman). — St. Thomas: on nestling *Columba leucocephala* and on *Oreopeleia mystacea beattyi* (G.A. Seaman). — Grenada: on *Zenaidura auriculata rubripes* (F. Root).

Colombia: Cali, Valle del Cauca, on domestic pigeon (S. Renjifo Salcedo).

Venezuela (recorded by Ad. Lutz and Nuñes-Továr, 1928): Caripito, State Monagas (P. Anduze); Santa María de Ipire, State Guarico, on *Colinus cristatus connini* (P. Anduze); Yagua, State Cojedes (H.A. Beatty).

Brazil (recorded by Ad. Lutz, Neiva and da Costa Lima, 1915): Deodoro, State Rio de Janeiro, on *Columbigallina* sp. (J.F. Zikan); Rio de Janeiro, D.F., on domestic pigeon; Maracajú, State Matto Grosso, on *Crypturellus* sp. (R.M. Gilmore).

Peru (recorded by Schuurmans Stekhoven, 1952): Lima, on 2 *Metropelia c. ceciliae* (W. Weyrauch); San Ramon, Valle Chanchamayo, 800m., on *Leptotila verreauxi decipiens* (W. Weyrauch).

Paraguay: San Bernardino, on domestic pigeon (K. Fiebrig).
Chile: Arica, on *Columbigallina cruziana* (O. Barros).

Although there are as yet relatively few records from south of the Mexican boundary, *M. pusilla* appears to be essentially a Neotropical insect. It will eventually be recognized as a common birdfly in Central and South America, as well as in the Antilles. In the United States, it is fairly common in the southwestern area, particularly in Texas, Arizona and southern California. Farther north it is very scarce, the few sporadic occurrences being no doubt due to temporary introductions during the summer on migrating hosts. It is particularly noteworthy that the several Californian records are all from the southern third of the state. The northmost localities are in Idaho (43° 20′ N.) and North Dakota (46° 50′ N.). East of the Mississippi the only reliable, native record is from Florida, the two occurrences in the District of Columbia being due to transport by Man. The southmost records are from northern Chile (18° 32′ S.) and Paraguay (25° 20′ S.).

Known Nearctic Hosts of *M. pusilla* (verified individual records in parentheses). Falconiformes (1 unnamed hawk). Galliformes (8): *Callipepla squamata pallida* (4); *Colinus v. virginianus* (3); *Lophortyx g. gambelii* (1). Columbiformes (15): **Columba l. livia* (3); *Scardafella inca* (1); **Streptopelia c. chinensis* (1); *Zenaida a. asiatica* (1); *Zenaidura macroura carolinensis* (4); *Z. macroura marginella* (5). Cuculiformes (8): *Geococcyx californianus* (8). Caprimulgiformes: *Caprimulgus carolinensis.* Passeriformes (18): *Arremonops rufivirgatus* (1); *Hedymeles m. melanocephalus* (1); *Mimus p. polyglottos* (1); *M. polyglottos leucopterus* (2); *Molothrus ater obscurus* (2); *Pipilo a. aberti* (4); *P. aberti dumeticolus* (1); *P. fuscus mesoleucus* (1); *Richmondena c. cardinalis* (2); *Sturnella m. magna* (1); *Toxostoma c. curvirostre* (1); *T. r. rufum* (1).

Known Neotropical Hosts of *M. pusilla.* Tinamiformes (1): *Crypturellus* sp. (1). Galliformes (1): *Colinus cristatus sonnini* (1). Columbiformes (15 and 1 unnamed pigeon): *Columba leucocephala* (1); **C. l. livia* (3); *Columbigallina* sp. (1); *C. cruziana* (1); *C. passerina nigrirostris* (1); *C. t. talpacoti; Leptotila rufaxilla reichenbachii; L. verreauxi decipiens* (1); *Metropelia c. ceciliae* (2); *Oreopeleia mystacea beattyi* (2); *Scardafella s. squammata; Zenaida asiatica mearnsi* (1); *Zenaidura articulata rubripes* (1); *Zenaidura macroura clarionensis* (1). Passeriformes (2): *Arremonops striaticeps* (1); *Toxostoma d. dorsale* (1).

Bionomics. Part I mentions what little is known of the natural

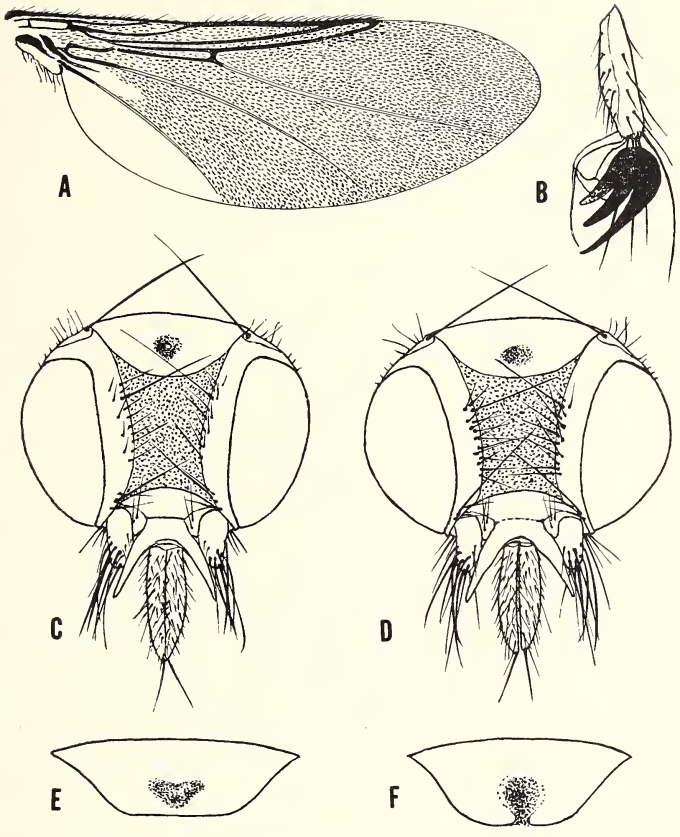

Fig. 73. *Microlynchia pusilla* (Speiser): **A**, wing, ♀, San Antonio, Tex., on *Zenaidura macroura carolinensis;* **B**, distitarsus and claw of hind leg, ♀, Sabinal, Tex., on *Geococcyx californianus;* **C**, head, ♀, Turrialba, Costa Rica, on wild pigeon, postvertex with 1 distinct vestigial ocellus; **D**, head, ♂, Bexar Co., Tex., on *Zenaidura macroura carolinensis,* postvertex with very small ocellus; **E**, postvertex, ♂, Arizona, on *Callipepla squamata pallida,* with 2 minute posterior ocelli; **F**, postvertex, ♀, St. Croix, on *Columbigallina passerina nigrirostris,* with large pit, but no trace of vestigial ocelli.

history of *M. pusilla*, under the following headings: possible transmission of *Haemoproteus columbae* (p.138) and the *Haemoproteus* of wild doves (pp. 357–358); infestation with Laboulbeniales (p. 141) and mites (p. 159); frequency and density on the host (p. 233); seasonal fluctuations (p. 256); acquisition of new hosts (p. 245); and host specificity (p. 324). Larviposition has not been observed and the puparium is unknown.

In spite of the paucity of records, particularly from the Neotropics, which are probably its main range, this fly is clearly a pleioxenous parasite, with regular breeding hosts in at least 3 and possibly 4 orders of birds. It is remarkable that it seems to shun diurnal and nocturnal Raptores. In the Nearctic Region it breeds chiefly on Columbiformes (5 species with 15, or 30 per cent, of the 50 verified records), Galliformes (3 species with 8, or 16 per cent of the records), and one of the Cuculiformes (*Geococcyx*, the roadrunner, with 8, or 16 per cent, of the records). It occurs rather frequently on Passeriformes (10 species with 18, or 36 per cent, of the records) and possibly some of these, such as *Pipilo aberti*, may also be used for breeding; but it is always much rarer on them than either *Ornithoica vicina* or *Ornithomyia fringillina*. In the Neotropics the majority of the records are from Columbiformes (13 species with 15, or 79 per cent, of the 19 verified records). The sporadic single occurrences on 3 other orders are probably accidental; but it seems strange that the fly would avoid Passeriformes almost completely in the tropics, when it is often found on some of these birds in the Nearctic Region. One fly said to have come from a tinamou in Brazil I am unable to distinguish from the other *M. pusilla;* yet it is far from settled that *M. crypturelli*, here regarded as a specific parasite of tinamous, is specifically distinct from *M. pusilla*. The natural partiality for Columbiformes no doubt explains the repeated findings of *M. pusilla* on the introduced domestic pigeon in North as well as in South America.

In the southern United States the fly is often found on birds during November, December, January, February, March and April, as well as during the summer, so that the adult evidently winters there on some of the hosts. In the northern states the fly is much rarer and has been taken only from April 20 to September 1. McClure (1943, p. 406) remarked on its scarcity in Iowa, where he found it only on 7 of some 1700 young mourning doves handled for banding.

The following cases of mite infestation are additional to the one mentioned in Part I:

2. Female fly on *Mimus polyglottos leucopterus*, at Fargo, North Dakota, with one mite cluster on under side of a basal vein in each wing.

3. One ♀ and 1 ♂ on *Oreopeleia mystacea beattyi*, in St. Croix, with a mite cluster on under side of a basal vein, in both wings in the ♂, in one wing only in the ♀.

The first case of phoresy of Mallophaga by *M. pusilla* was noticed recently. A ♀ taken on *Zenaidura macroura marginella*, at Lincoln, Neb., carried 2 lice fixed to the left dorsal side of the abdomen.

Affinities. The very close relationship of *M. pusilla* and *M. crypturelli* will be discussed under the latter. *M. pusilla* varies relatively little in size, the wing being 3.8 to 4.5 mm. long and 1.5 to 1.7 mm. wide. The interocular face is usually at its narrowest (at the lower third) about $1\frac{2}{3}$ times, and at its widest nearly twice the width of an eye in the ♀ (Fig. 73*C*) and slightly narrower (nearly $1\frac{1}{2}$ times as wide as an eye) in the ♂ (Fig. 73*D*); but there is so much variation in this respect in both sexes that this width can scarcely be used to separate them. The inner margins of the eyes are slightly farther apart at the postvertex than at the lunula. The venation varies little, except in the ending of the subcosta. A series of 64 flies examined for this character is about evenly divided in those with complete and those with incomplete subcosta. The vein is complete in both wings in 31 flies (13♀ and 18 ♂) from Arizona, California, Texas, Mexico, St. Thomas, St. Croix, Venezuela and Colombia, on domestic pigeon, *Callipepla squamata, Columbigallina, Oreopeleia mystacea, Zenaidura macroura, Colinus cristatus, Geococcyx californianus,* and *Hedymeles melanocephalus.* It is incomplete in both wings in 31 flies (23 ♀ and 8 ♂) from Arizona, New Mexico, North Dakota, Texas, St. Thomas, Costa Rica, Venezuela, Brazil and Paraguay, on domestic pigeon, *Callipepla squamata, Crypturellus, Geococcyx californianus, Arremonops striaticeps, Mimus polyglottos,* and *Pipilo aberti.* The remaining 2 flies, both ♀, from St. Croix, on *Columbigallina passerina,* and from Texas, on *Zenaidura macroura,* have the vein complete in one wing and incomplete in the other. When incomplete the vein is often much shortened; but occasionally it stops just short of the costa or fades out very gradually. The first section of 4th longitudinal vein is nearly as long as the last section of the 3rd longitudinal.

Normally the scutellum has one pair of discal (or preäpical) bristles (1 in each corner), in addition to some very short, soft

setulae (Fig. 72*A*). Of 5 flies taken on one *Mimus polyglottos leucopterus* at Fargo, N. Dak., 1 ♀ and 1 ♂ have the normal pair; 1 ♀ has 2 pairs (4 bristles in all); and 2 ♀ have 3 bristles (1 in one corner and 2 in the other). Of 9 flies from *Oreopeleia mystacea beattyi* in St. Thomas, only 1 ♀ has the normal pair; 5 ♀ and 2 ♂ have 2 pairs (4 bristles in all); and 1 ♀ has 5 bristles in all, 2 in one corner and 3 in the other (Fig. 72*F*). Such specimens are evidently abnormalities, as I was unable to detect any other difference between them and the flies with one pair of bristles.

The median dorsal sclerite of the abdomen is variable in size and shape in the ♀, although in most specimens it is about as shown in Fig. 72*E*. In one ♀ from Yuma, Ariz., on *Pipilo a. aberti*, it is greatly reduced and divided into two plates barely connected across the middle.

M. pusilla is often fairly regularly marked with pale, bone-white spots, which cover most of frons (except for black tips of apical arms), inner orbits, postvertex, humeral callosities, dorsal anepisternum, squarely triangular antero-lateral areas of prescutum, anterior face of fore femora and fore tibiae, upper side of fore tarsi, and anterior half or more of scutellum. These markings are, however, lacking in some specimens, and these do not differ in any structural peculiarity from the spotted flies.

Speiser (1902) stated merely that the "vertex" (= postvertex) was "medially with a pit." Lutz, Neiva and da Costa Lima (1915) first called attention to the "presence of ocelli, albeit poorly visible, at the bottom of the small pit described by Speiser." They used this as one of the characters separating their new genus *Microlynchia* from *Pseudolynchia* (their "*Lynchia*"). Ferris (1930*c*, p. 66) commented on this as follows: "The presence of the ocelli, if it were not a variable character, would separate the genus from all its immediate relatives except *Ornithophila*. Of the 3 specimens [from Thatcher, Ariz., on domestic pigeon] examined in slide preparations, which make detailed study possible, one lacks the ocelli entirely, their position being indicated by a pore-like pit similar to that which is present in some species of *Lynchia* (= *Olfersia* of authors); one has 3 minute but quite distinct ocelli and the third has 2. In the latter cases the ocelli are borne in a distinct pit." My own observations only confirm Ferris' conclusion. A deep pit, variable in size, is present on the postvertex of all flies examined; in a very few the pit shows no trace of ocelli; in most of them there are from 1 to 3 vestigial ocelli, very variable in size, but always placed in the pit, either crowded together or farther apart. If

only one ocellus is present in the center of the pit, it is sometimes large and quite convex. Figs. 73*C-F* show some of these conditions, as well as variations in the shape of the postvertex.

Original description of *L. pusilla* (translated from the German): "Length of body, 3 mm.; from oral margin to hind margin of scutellum, nearly 2 mm.; of wing, nearly 4 mm. Ground color umber-brown, with paler head, a pale longitudinal line on thorax, pale contrasting anterior angles and pale fore margin of scutellum; legs pale leather-yellow. Head only slightly narrower than thorax, with evenly rounded vertex [occipital margin]. Frons [interocular face] very little narrowed anteriorly, somewhat dull medially [mediovertex], shiny along the margins of the eyes [inner orbits] and on the triangle of the vertex [postvertex]; the latter broadly rounded anteriorly, with entire margin, medially with a pit. Clypeus oris [frons] divided as usual by a transverse suture into two parts, the anterior part ending in a deep and acute emargination, so that it consists mostly of two bone-yellow, divergent tips which extend beyond the antennal appendages. Antennal appendages very small, shiny chestnut-brown, with black bristles. Maxillary palpi half the length of the frons [interocular face], straight, of medium width, brown with basal half paler above. The pattern of the thorax recalls that of *Olfersia* [=*Lynchia*] *americana* Leach, as figured by Leach, being similarly variegated and divided. The ground color is umber-brown, with leather-yellow median line, yellowish-brown anterior edges not only on the humeral lobes [callosities] but also over the adjoining areas of the prescutum; the yellowish-brown color stops nearly rectangularly inside. Fore margin of scutellum also with a narrow yellowish-brown edge. Anterior margin of thorax straight, with only the humeral lobes [callosities] projecting on each side; longitudinal [median notal] suture very fine; transverse [mesonotal] suture almost at right angles with it, groove-like laterally, very fine but not effaced medially. Scutellum scarcely truncate, nevertheless shorter in proportion to its width than in a true *Olfersia* [=*Lynchia*]. No characteristic pilosity. Legs pale; claws with accessory tooth. Fore femora with a row of short, stiff bristles, placed at right angles with the long axis, setting off a basal bare portion from a peripheral setose area. The other legs appear bare. Wings slightly tinged with grayish hazel-brown, without peculiarities. Radialis [2nd longitudinal] ending so close to the cubitalis [3rd longitudinal] that the apical section of the costa is less than half as long as the penultimate section. No other observations on the venation. Abdomen hidden from view by the folded wings." I have not seen the type, which should be at the Berlin Museum. It should be examined more critically, as the original description mentions little beyond color. My interpretation of *M. pusilla* follows that of Lutz, Neiva and da Costa Lima (1915) and of Ferris (1930). There is no reason to doubt that it is correct.

Microlynchia crypturelli J. Bequaert

Figs. 74*A–E*

Microlynchia crypturelli J. Bequaert, 1938, Rev. de Entomologia, Rio de Janeiro, **9**, p. 346, figs. 1–2 (♀; on *Crypturellus soui panamensis*. Panama: La Vaca, Chiriqui Prov. Holotype and 1 paratype at Mus.Comp.Zool., Cambridge, Mass.; 1 paratype at U.S.Nat.Mus., Washington); 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1943, Jl. of Parasitology, **29**, p. 131.

Distribution and Specimens Examined. PANAMA: La Vaca, Chiriqui Prov., R.P., on *Crypturellus soui panamensis*, ♀ holotype and 2 ♀ paratypes (L.H. Dunn.—Mus.Comp.Zool., No. 29434).

Brazil: Nova Teutonia near Itá, State Santa Catharina, on *Crypturellus o. obsoletus* and 6 ♀ and 3 ♂ (including the allotype) on *Columba rufina sylvestris* (F. Plaumann. — Allotype at Mus.-Comp.Zool., No. 29434); Fazenda Recreio, Coxim, State of Matto Grosso, on *Crypturellus parvirostris* (J. Lima).

No doubt *M. crypturelli* is more widely distributed in tropical America than the few available records indicate. If it is a specific parasite of tinamous, as I suspect, it may be difficult to collect because of the secretive habits of these forest birds.

Bionomics. The few host records of *M. crypturelli* are mostly from tinamous (Tinamiformes, Tinamidae): *Crypturellus o. obsoletus* (1); *C. parvirostris* (1); *C. soui panamensis* (1). It seems probable that these birds are the true and perhaps only breeding hosts, but further observations are needed to confirm this. The specimens reported from a wild dove, *Columba rufina sylvestris*, in Brazil, were said to have come from 3 birds at different dates; they may nevertheless have been accidental, or perhaps due to *post mortem* contaminations or to some oversight in labeling. I now disregard also the occurrence on one of the Phasianidae, *Odontophorus c. capueira,* at Nova Teutonia, recorded in an earlier paper (1943*c*, p. 131), as this was based on an oversight.

In Part I (p. 159) I mentioned a case of infestation with mites. Not much else is known of the life history.

Affinities. As mentioned before, *M. pusilla* and *M. crypturelli* are very similar and I am far from satisfied that they are specifically distinct. The only differences now regarded as reliable are given in the key. Unfortunately these are mostly of degree, hence difficult to appreciate when both species are not available for comparison. The problem is also complicated by the fact that, while *crypturelli* presumably breeds only on tinamous, *pusilla* seems to occur occasionally (perhaps as a stray) on the same type of bird.

Revised description. *Female.* Head (Fig. 74*C*) in front view about as wide across eyes as high from occipital margin to tips of apical arms of frons; interocular face at its narrowest slightly over $1\frac{1}{4}$ times as wide as an eye, nearly as high along inner orbits as its greatest width at postvertex; eyes farther apart at postvertex than at lunula, nearest to each other at lower third; inner orbits slightly less than half as wide as mediovertex; orbital bristles few and mostly weak: a short row of 3 or 4 (one very long) near lunula; 12 to 15 (one very long) higher up, mostly in one row near edge of mediovertex, but some farther outside in an irregular second row; one long vertical bristle; postvertex semi-elliptical, slightly less

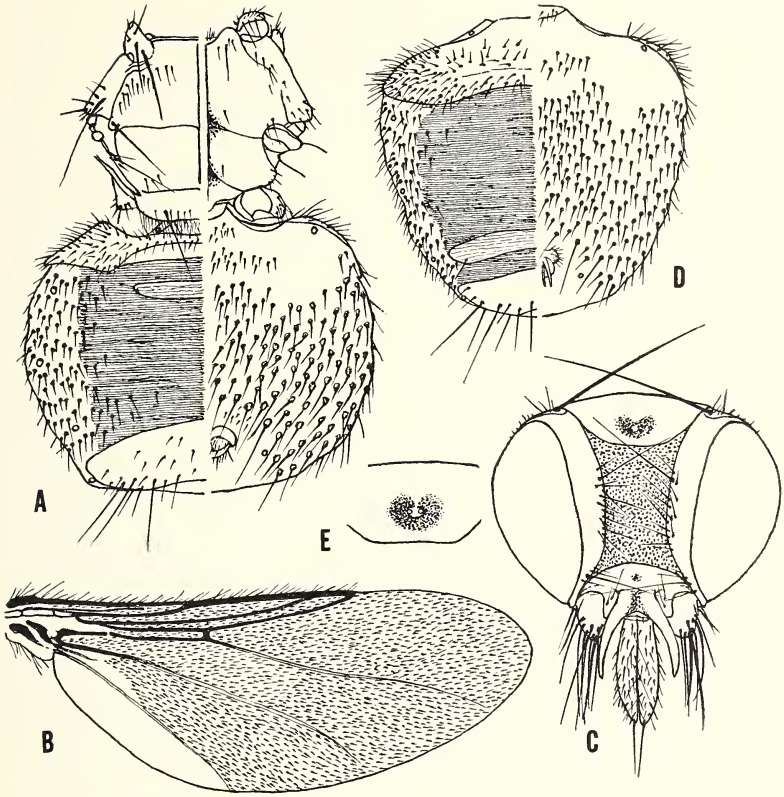

Fig. 74. *Microlynchia crypturelli* J. Bequaert: **A–C**, ♀ holotype, La Vaca, Panama, on *Crypturellus soui panamensis:* **A**, thorax and abdomen dorsally and ventrally; **B**, wing; **C**, head; **D–E**, ♂, Nova Teutonia, Brazil, on *Columba rufina sylvestris:* **D**, abdomen dorsally and ventrally, allotype; **E**, pit of post-vertex of another ♂ with 2 vestigial ocelli.

than half as long as mediovertex, with slightly convex occipital margin and evenly, broadly rounded anterior margin; disk with an irregular pit variable in size and shape, usually more or less horseshoe-shaped; the bottom of the pit is raised into a low tubercle, either without or with 1 to 3 vestigial ocelli (2 ocelli in Fig. 74*E*). Frons: lunula and interantennal area very superficially separated by a transverse suture; basal portion of interantennal area narrower than its shortest distance from the eyes, with a distinct longitudinal groove; apical arms long, narrow, prong-like, nearly straight, extending far beyond tips of antennae. Palpi moderately long, slightly shorter than mediovertex. Antennae short: 1st segment almost completely fused with lunula, with a few setulae; 2nd segment nearly twice as long as 1st, moderately bristly over outer apical half. Thorax (Fig. 74*A*): anterior margin of prescutum nearly straight; humeral callosities moderately broad, short, obtusely pointed at apex, with a few short, stiff setae anteriorly and 2 long bristles on the disk; mesonotum as in *M. pusilla*. Scutellum transversely rectangular, about 4 times as wide as long; sides broadly rounded off; hind margin very slightly curved inward; edge below with a fringe of soft setulae; disk with one long preäpical bristle on each side in a line with a few very weak setulae. Metathoracic pleurotergite broadly conical, a little over half as long as scutellum, with a few stiff, short setae. Sternum: meta-basisternum without metasternal spurs. Wing (Fig. 74*B*): microtrichia over most of membrane; only entire postaxillary cell, a very small basal area in the combined anal, 3rd posterior and axillary cells, and extreme base of 1st basal cell bare; 1st section of 4th longitudinal vein shorter than last section of 3rd; subcosta incomplete, not reaching costa (in both wings of 12 flies examined), sometimes much shortened and ending opposite the beginning of 3rd longitudinal. Legs as usual. Abdomen (Fig. 74*A*): basal fused laterotergites expanded at the sides as diamond-shaped lobes, the hind margin evenly and very broadly emarginate medially; median transversely striolate area very broad, with very few setae; sides of dorsum with mostly short setae on medium-sized papules; preäpical tergite large, transversely elliptical, with a few very short setae and on each side an apical group of 4 or 5 long bristles; venter soft and membranous, sparsely setose in the middle, more densely at the sides and toward the apex, where the setae are inserted on fairly large, prominent tubercles. Length from tips of apical arms of frons to hind margin of scutellum, 2 to 2.4 mm.; of wing, 4.4 to 5.3 mm.; width of wing, 1.8 to 2 mm.

Male. Very similar to the ♀, except as follows. Abdomen (Fig. 74*D*) dorsally with the basal fused laterotergites about equally long throughout, the hind margin not emarginate but only slightly curved inward medially; median sclerite differentiated in the striolate area very broad (transversely), short, ribbon-like, placed far back, toward the large preäpical tergite, its surface also with superficial, spaced transverse striae; ventrally with many setae on medium-sized papules, not on prominent tubercles. Length from tips of apical arms of frons to hind margin of scutellum, 2 to 2.2 mm.; of wing, 4.4 to 4.6 mm.; width of wing, 1.5 to 1.8 mm.

In all *crypturelli* seen the 1st (basal) section of the 4th longitudinal vein is much shorter than the last (apical) section of the 3rd; in most *pusilla* these 2 sections are about the same length, but some of them scarcely differ in this respect from *crypturelli.* The postaxillary cell at its widest is narrower than the combined anal, 3rd posterior and axillary cells at the same level in *crypturelli,* while in *pusilla* these 2 cells are about equally wide. Other supposed differences mentioned in the original description, copied below, have proved intenable.

Original description of *M. crypturelli:* "*Female.* Head seen in front less than $1\frac{1}{3}$ times as wide as high; frons at its narrowest about $1\frac{1}{3}$ times as wide as the eye, measured along inner orbits a little longer than its greatest width at the vertex, the sides strongly converging from vertex to fronto-clypeus; inner orbits (parafrontalia) about half as wide as the mediovertex (frontalia), mostly smooth and bare, the inner margin with a few short soft setae, placed in one irregular row, and two long bristles, one at the lower third, the other near the ptilinal suture; one long vertical bristle; postvertex (vertical triangle) long, semi-elliptical, about half the length of the mediovertex, the anterior margin evenly rounded off, the occipital margin slightly convex, the disk with a slight median tubercle, limited on the sides and anteriorly by an irregular, furcate depression; the very small, rudimentary ocelli are crowded together on this median tubercle; anterior portion of fronto-clypeus narrowly and very deeply emarginate in the middle, the antero-lateral angles forming very long, narrow, straight prongs, which extend far beyond the tips of the antennae. Palpi moderately long, about half as long as the height of the head (measured from occipital margin to bottom of emargination of fronto-clypeus). Antennae short, of normal shape. Thorax of the usual shape; anterior margin nearly straight; humeral lobes moderately long, broad, obtusely pointed at apex; transverse and longitudinal grooves of mesonotum deep and nearly complete. Scutellum transversely rectangular, about 4 times as wide as its length in the middle, the anterior (mesonotal) margin slightly convex, the sides broadly rounded off, the hind margin very slightly concave. Humeral lobes with a few short setae at apex and a long bristle before the middle; anterior half of mesonotum (prescutum) with a few short, soft hairs on the sides in a transverse patch; one very long preälar and one very long postalar bristle; dorsal portion of mesopleura (notopleura) posteriorly with a few short and one very long bristles; scutellum with an apical fringe of long hairs and one long scutellar bristle on each side; metepimeron with 4 or 5 short, stiff bristles. Integument of entire mesonotum minutely and rather regularly, obliquely striolate. Legs without distinctive features, moderately long. Wing short and

broad; microtrichia covering most of the membrane, only the axillary cell, part of the base of the combined anal and 5th [correctly 3rd] posterior cells, and extreme base of 1st basal cell bare; 1st basal cell long, narrow, parallel-sided; subcosta incomplete or much weakened apically, not reaching the costa; 1st (basal) section of 4th longitudinal vein shorter than last (apical) section of 3rd longitudinal vein; costa densely setulose; other veins bare. Abdomen with a broad, short basal tergite, widened into truncate lateral lobes and very evenly and broadly emarginate in the middle; remainder of dorsum mostly soft and membranous, with faint traces of segmentation and a well-defined transversely elliptical median sclerite a short distance behind the basal tergite; the median area bare and microscopically transversely striolate; the softer sides covered with short setae arising from papulae; preänal tergite forming a single, transversely elliptical sclerite, bearing a few very short setae and on each side a preäpical row of 4 or 5 long bristles; venter soft and membranous, sparsely setulose in the middle, more densely on the sides and with a few longer bristles posteriorly. Total length, from notch of fronto-clypeus to apex of abdomen (dry, pinned specimen): 3 mm.; length of wing: 4.6 mm.; width of wing; 1.5 mm. The main differences between this species and *M. pusilla* are pointed out in the key. In addition, the ocelli of *M. crypturelli* are more rudimentary than in *M. pusilla;* the postvertex is longer and more evenly rounded off anteriorly; the hind margin of the scutellum is slightly curved inward; and the sculpture of fine striae is more extensive over the mesonotum. In the specimens seen the subcosta is incomplete, but this peculiarity does not appear to be of specific value in *Microlynchia.*'' The original description is copied here only for the sake of completeness. The revised description given above should be used for the true characters of the species.

Microlynchia furtiva, new species

Figs. 75*A–C*

Female. Head (Fig. 75*C*) in front view about as wide across eyes as high from occipital margin to tips of apical arms of frons. Interocular face at its narrowest nearly twice as wide as an eye, nearly as high along inner orbits as its greatest width at postvertex; eyes slightly farther apart at postvertex than at lunula, nearest at about mid-length. Inner orbits about $\frac{1}{4}$ of width of mediovertex at its narrowest; orbital bristles few, mostly weak: a group of 3 (one very long) near lunula; 10 on each side farther up near edge of mediovertex (one very long), in one row. Postvertex only slightly over twice as wide as long, semi-elliptical, with slightly arched occipital and evenly rounded anterior margin, with an irregular antero-median pit in which no vestigial ocelli can be traced; one long vertical bristle. Frons: lunula completely fused with interantennal area; the portion between the antennae long and very wide, wider than its shortest distance from eyes, the surface very shallowly depressed medially; apical arms broad, short, strongly diverging, separated basally by a narrow, almost semicircular notch, rather abruptly narrowed to short, triangular points which extend moderately beyond the tips of the antennae. Palpi very long, longer than height of eye, about as long as combined mediovertex

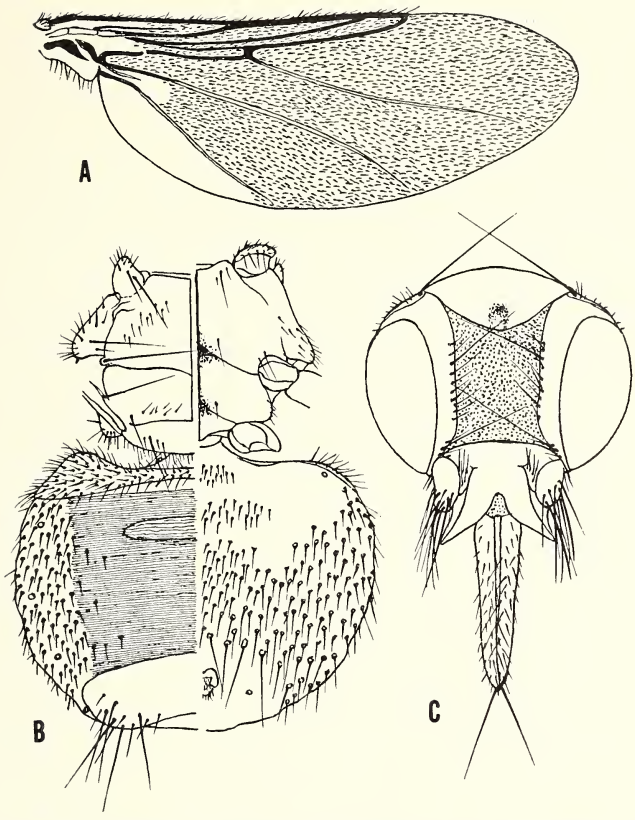

Fig. 75. *Microlynchia furtiva* J. Bequaert: **A–C**, ♀ holotype, El Cayo, Honduras, on *Crypturellus b. boucardi:* **A**, wing; **B**, thorax and abdomen dorsally and ventrally; **C**, head.

and postvertex (from occipital margin to ptilinal suture). Antennae: 1st segment fused with sides of lunula, with a few setulae; 2nd segment nearly twice as long as 1st, broadly rounded-truncate at apex, moderately bristly over outer apical half. Thorax (Fig. 75*B*) as usual in *Microlynchia:* anterior margin of prescutum nearly straight medially; humeral callosities moderately wide, short, slightly produced anteriorly, ending in blunt, rounded points, with a few short setae anteriorly and 2 long bristles on disk; anepisternum with a few short setae and one long discal bristle posteriorly; one long notopleural bristle; one long postalar bristle; a small, oblique patch of short appressed setae on each side of prescutum; a few small setae in a prescutellar group on each side and,

in this, a long stiff bristle in each hind corner (this bristle, not found in any of the congeners, may be an individual abnormality and not a specific character). Scutellum as in *M. pusilla,* with a lower apical fringe of soft setulae and one long, stiff discoscutellar bristle in each corner in a row with a few short, soft preäpical setulae; surface even, very slightly convex; hind margin with a very slight outward curve. Metathoracic pleurotergite moderately prominent, forming a low, broad cone, not quite half as long as scutellum, with a few short, stiff setae apically. Sternum as in *M. pusilla;* meta-basisternum without metasternal spurs. Legs longer and more slender than in *M. pusilla,* without special features. Wing (Fig. 75*A*) : only postaxillary cell bare, except for a few microtrichia at extreme tip; subcosta incomplete in both wings; venation as in *M. pusilla.* Abdomen (Fig. 75*B*) as in the congeners; median sclerite differentiated in the striolate area close behind the fused basal laterotergites, large, transverse, with spaced, rather well-defined transverse striae.

Length from tips of apical arms of frons to hind margin of scutellum, 3.3 mm.; of wing, 6.4 mm.; width of wing, 2.7 mm.

British Honduras: El Cayo, ♀ holotype on *Crypturellus b. boucardi* (J. Van Tyne Coll. — Mus.Comp.Zool., Cambridge, Mass., No. 29239; preserved in alcohol).

Remarkable for the very long palpi and the peculiar structure of the frons. It is the hippoboscid with the longest palpi as compared to the total length of the head, even exceeding in this respect the Oriental *Lynchia longipalpis* (Macquart) (= *L. majuscula* J. Bequaert).

Microlynchia galapagoensis, new species
Figs. 76*A–D*

Female. Head (Fig. 76*C*) in front view about as wide across eyes as high from occipital margin to tips of apical arms of frons. Interocular face at its narrowest about twice as wide as an eye, nearly as high along inner orbits as its greatest width at postvertex; eyes slightly farther apart at postvertex than at lunula, nearest together at about mid-length. Inner orbits a little less than half as wide as mediovertex at its narrowest; orbital bristles few, mostly weak, in one row: a group of 3 (middle one long) near lunula; 8 along edge of mediovertex, mostly very weak, but one long and stiff near upper third of face. Postvertex about 3 times as wide as long, transversely semi-elliptical, with slightly arched occipital and nearly straight anterior margin; an antero-median pit with a minute, but

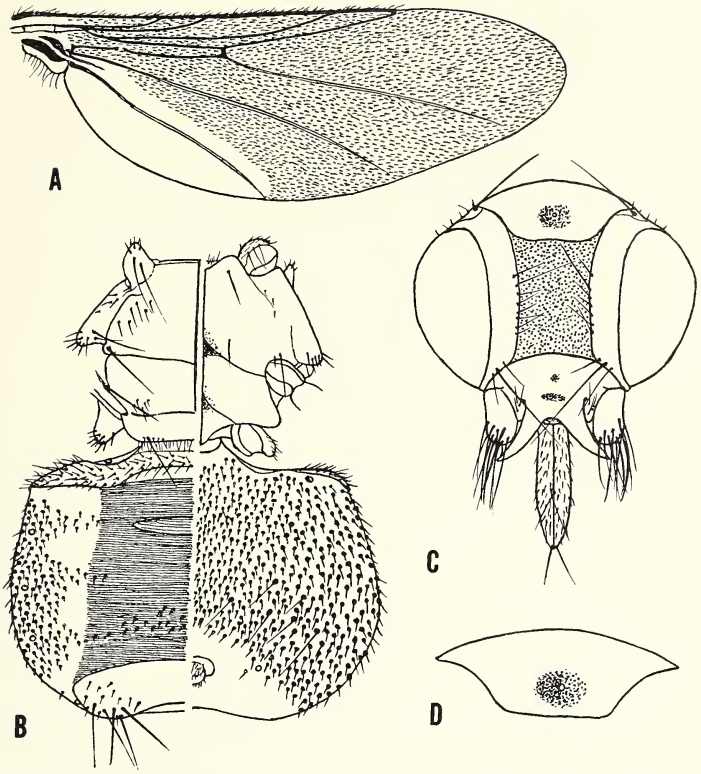

Fig. 76. *Microlynchia galapagoensis* J. Bequaert: **A–C**, ♀ holotype, Indefatigable I., Galapagos, on *Nesopelia galapagoensis:* **A**, wing; **B**, thorax and abdomen dorsally and ventrally; **C**, head; **D**, postvertex with vestigial ocellus in a pit, ♀ paratype, Hood I., Galapagos, on *Buteo galapagoensis.*

distinct vestigial ocellus in the bottom (Fig. 76*D*). Frons: lunula and interantennal area completely fused, the suture replaced by a broad depression; above this a very small discal pit; area between antennae moderately long, as wide as its shortest distance from eyes, scarcely depressed; apical arms moderately wide, short, strongly diverging, separated basally by a broad notch, gradually narrowed to the apices. Antennae: 1st segment fused with sides of lunula, with a few setulae; 2nd segment nearly twice as long as 1st, broadly rounded-truncate at apex, moderately bristly over outer apical half. Palpi longer than in *M. pusilla* and *M. crypturelli,* but much shorter than in *M. furtiva,* shorter than height of eye, slightly shorter than mediovertex. Thorax (Fig. 76*B*) as in the

congeners: humeral callosities broad, short, moderately produced anteriorly, ending in blunt, rounded points, with a few short setae anteriorly and 2 long discal bristles; anepisternum with a few short setae and one long discal bristle posteriorly; one long notopleural bristle; one long postalar bristle; an oblique patch of spaced, appressed, short setae on each side of prescutum; a few small setae in a prescutellar group on each side of mesoscutum. Scutellum somewhat shorter and broader than in the congeners, with the usual apical fringe of soft setulae and one long discal bristle on each side in a row of weak preäpical setae; surface even, very slightly convex; hind margin nearly straight. Metathoracic pleurotergite very prominent, more so than in the congeners, forming a broadly rounded lobe, about as long as scutellum, setulose apically. Sternum as usual in the genus; no metasternal spurs. Legs relatively long and slender, without peculiarities. Wing (Fig. 76*A*) more extensively bare than in the congeners, not only over entire postaxillary cell, but also over most of hind third of combined anal, 3rd posterior and axillary cells (except near tip of axillary vein); subcosta complete in both wings in holotype and paratype; venation as usual. Abdomen (Fig. 76*B*): one median sclerite differentiated in the striolate area, a short distance behind the fused basal laterotergites, with spaced, coarse transverse striae; setae of the softer sides mostly short and thick, inserted on strong tubercles, both on dorsum and venter; ventrally on each side at about mid-length with 5 or 6 long setae on tubercles amongst the shorter setae; apical tergite shorter and wider than usual, mostly bare, at the sides only with a few setulae and 5 or 6 long, stiff bristles.

Length from tips of apical arms of frons to hind margin of scutellum, holotype, 2.6 mm. (paratype, 2.6 mm.); of wing, holotype, 4.8 mm. (paratype, 4.5 mm.); width of wing, holotype, 1.5 mm. (paratype, 1.4 mm.).

Galapagos: Academy Bay, Indefatigable I., ♀ holotype on *Nesopelia galapagoensis* (Crane Pacific Exped. — Mus.Comp.Zool., Cambridge, Mass., No. 29432); Hood I., ♀ paratype on *Buteo galapagoensis* (W.S. Brooks. — Mus.Comp.Zool., Cambridge, Mass., No. 29432).

This species is well defined by the characters given in the key. The more extensive bare area of the wing and the prominent metathoracic pleurotergite are especially diagnostic.

Pseudolynchia J. Bequaert, 1926

Lynchia Speiser, 1902, Zeitschr. Syst. Hym. Dipt., 2, p. 155. Not of Weyenbergh, 1881.

Pseudolynchia J. Bequaert, 1926, Psyche, **32**, (for 1925), p. 271 (type by original designation: *Olfersia maura* Bigot, 1885 = *Olfersia canariensis* Macquart, 1840).

Generic Characters. Fully-winged parasites of birds, agreeing with *Lynchia,* except as noted here. Integument of head and thorax sometimes with metallic-green sheen, never with enamel-white areas; haemolymph without dull-greenish pigment. Ocelli lacking; anterior margin of postvertex with a median emargination sometimes extended to a small discal pit. Frons divided by a distinct transverse suture into a lunula and a narrower interantennal area; the latter deeply emarginate, ending in two short, diverging apical arms. Under side of head (Figs. 81*B* and *F*) with the facial ridge (which continues the apical arms of the frons ventrally) ending in a protuberant, somewhat lobate *vibrissal angle* (*van,* corresponding to the insertion of the vibrissa in Muscoidea). Antennae short: 1st segment completely set off by a suture from lunula, with a few setulae; second segment short, broadly rounded or subtruncate at apex, not extending beyond lower margin of antennal pit, the outer margin with a long dorsal furrow (*AF* in Fig. 78*H,* corrected from Fig. 11*F*); arista of 3rd segment ending in a flattened, ovate, thin, transparent spatula (Fig. 6*C*). Dorsum of thorax (Fig. 78*A*) as in *Lynchia,* including the fusion of notopleuron and prescutum and the single notopleural bristle borne on a rounded lobe. Scutellum large, transverse, nearly rectangular, much wider than long, with a narrow, triangular, rugulose median depression, widest and deepest anteriorly; hind margin straight, at each square corner with a short row of finger-shaped protuberances each bearing a tuft of soft setulae (Figs. 78*D–E*). Metathoracic pleurotergite low, transverse, slightly convex, without differentiated process. Sternum flatter than usual, with deep furcal pits; prosternum divided into two broad lobes by a median concavity (as in some *Lynchia*); outer (side) margin of meta-basisternum produced as a tooth (metasternal spur) over base of hind coxa (as normally in all *Stilbometopa* and in a few species of *Lynchia*); hind margin of meta-furcasternum slightly emarginate, each side forming a short, broad lobe; longitudinal median sternal suture as in *Lynchia,* lacking over meta-furcasternum. Prothoracic and metathoracic spiracles as in *Lynchia.* Legs and claws (Fig. 78*I*) as in *Lynchia.* Wing (Figs. 79*A,* 80, 81*E* and 82) large, with the venation more reduced than in *Lynchia,* both posterior basal and anterior basal cross-veins lacking; anal cell combined with 3rd posterior and axillary cells; 2nd basal cell fused with 2nd posterior cell; as in *Lynchia* and *Micro-*

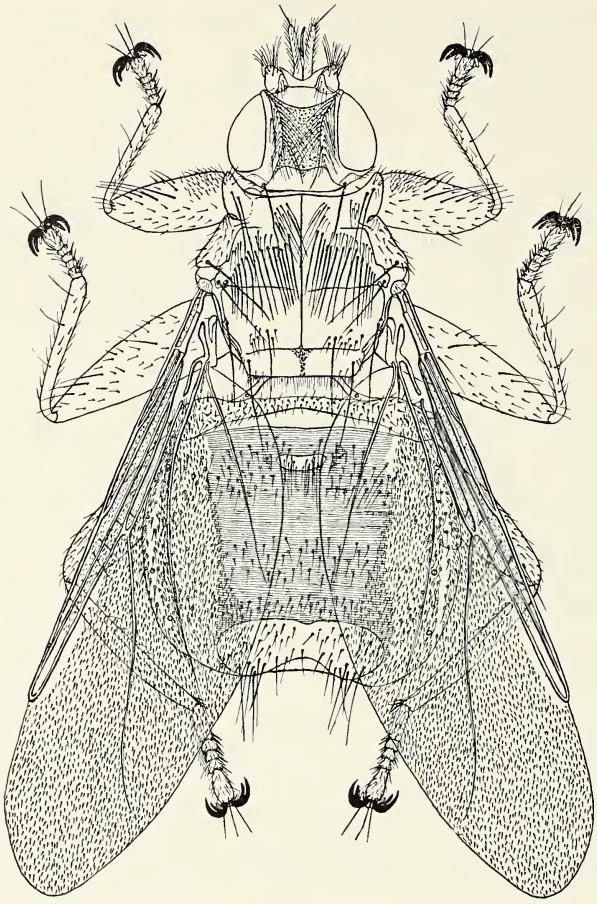

Fig. 77. *Pseudolynchia canariensis* (Macquart). ♀, Djakarta, Java, on domestic pigeon. × about 13.

lynchia, 6th longitudinal vein reduced to a short, weak, mostly discolored stump; axillary vein well developed, followed by a broad postaxillary cell in which a longitudinal crease often simulates a spurious vein; subcosta usually complete, ending in costa; 2nd longitudinal vein approaching the costa about mid-way between tips of 1st and 3rd longitudinals and then gradually fusing with it; membrane extensively covered with microtrichia; alula rudimentary, reduced to a very narrow membrane, somewhat wider toward apex; calypteres as in *Lynchia.* Abdomen (Figs. 78*F–G* and 81*A* and *D*) as in *Lynchia:* dorsally with an extensive, nearly bare,

densely and finely striolate median area, in which a small median sclerite is differentiated in both sexes behind the fused basal laterotergites; in the ♂ in addition with a posterior pair of small sclerites basad of the large, transverse preäpical tergite. Abdominal spiracles as in *Lynchia.* Body more densely setulose than usual, particularly on inner orbits (always with several rows of bristles) and on antero-lateral areas of prescutum; normally one vertical bristle (exceptionally 2 as an abnormality). Scutellum with one long discal bristle near each corner, sometimes in a row of weak setulae, and an apical fringe of soft setulae continuing the tufted lateral digitations. Sternum with very few setae. Male terminalia (Fig. 79*F*) similar to those of *Lynchia;* the setigerous lobes at the sides of the genital atrium rather large.

Speiser's diagnosis of *Lynchia* (1902) covered strictly speaking only *Olfersia maura* Bigot (= *Olfersia canariensis* Macquart) and related species and synonyms (*lividicolor* Bigot; *capensis* Bigot; *exornata* Speiser; *garzettae* Rondani; and *rufipes* Macquart). Only these agree with his description of the scutellum ("scutellum always strongly transversely truncate, nearly 4 times as wide as long") and of the venation ("remarkable and characteristic because of the entirely open 2nd basal cell, the anterior basal cross-vein being completely absent"). These peculiarities are not present in the other species included by Speiser, *Lynchia penelopes* Weyenbergh, the original monotype of *Lynchia,* and *Olfersia aenescens* Thomson, a species now properly placed in *Olfersia.* Because of this, *Pseudolynchia* was proposed for *Olfersia maura* and its allies, which Speiser had called *Lynchia* by error, as the type of *Lynchia* is not congeneric with them.

I recognize at present in *Pseudolynchia* 3 species only, which are very closely related: *P. canariensis* (Macquart, 1840), *P. brunnea* (Latreille, 1812), and *P. rufipes* (Macquart, 1848). *Pseudolynchia fradeorum* Tendeiro (1950, p. 127), recently described from Portuguese East Africa (Maputo, Lourenzo Marques Distr., on *Bubo africanus*), I can only regard as a synonym of *P. rufipes,* a common parasite of African owls. *P. brunnea* is restricted to the New World. The other two species were originally endemic in the Old World, particularly in the tropical and subtropical areas; but *P. canariensis* has been spread by Man with domestic pigeons to nearly all parts of the world.

Although differing only in minor characters, the 3 species of *Pseudolynchia* show the usual lack of correlation between the affinities of the parasites and those of their hosts. *P. brunnea* is strictly

specific of Caprimulgiformes. *P. canariensis* is chiefly a parasite of wild and domestic Columbiformes; but in its original Old World habitat it also uses as breeding hosts certain Falconiformes and possibly even Cuculiformes. The inadequate information now available for *P. rufipes* tends to show that its normal or, at any rate, preferred breeding hosts are Strigiformes and Caprimulgiformes; but it is interesting that it is not restricted to the Caprimulgidae, like its American congener, *P. brunnea.*

The bionomics of few other Hippoboscidae have been as thoroughly investigated as those of *P. canariensis,* owing to its economic importance as a pest and as the vector of a malaria-like disease of domestic pigeons (Part I, pp. 354–358). The puparium, known only for *P. canariensis,* is similar to that of *Lynchia.*

Key to American Species of *Pseudolynchia*

1. Wing with the combined anal, 3rd posterior and axillary cells almost wholly covered with microtrichia; only postaxillary cell bare. Interocular face about twice as wide as an eye. Wing 4.8 to 6 mm. long ..... *P. brunnea*

   Wing with the posterior area of the combined anal, 3rd posterior and axillary cells, as well as the postaxillary cell, bare. Interocular face less than twice as wide as an eye. Wing 4.5 to 7.5 mm. long ..... *P. canariensis*

Pseudolynchia canariensis (Macquart)

Figs. 6*A–C*, 7*A–D*, 11*F*, 13*E*, 77, 78*A–I*, 79*A–H* and 80

Olfersia canariensis Macquart, 1840, in Webb and Berthelot, Hist. Nat. Iles Canaries, **2**, pt. 2, Entomologie, p. 119 ("♀"; no host. Canary Islands. Type ♂ [not ♀] at Paris Mus.); 1843, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1842), p. 434 [1843, Dipt. Exot., **2**, pt. 3, p. 277].[52]

Pseudolynchia canariensis J. Bequaert, 1935, Rev. Zool. Bot. Afric., **27**, pp. 396 and 397, figs. 1*D–E;* 1938, Ent. News, **49**, p. 42; 1939, Science, **89**, p. 268. Herms, 1939, Medical Entomology, 3rd Ed., p. 379. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, p. 324; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416. Levi, 1941, The Pigeon, pp. 292, 318, and 319, fig. (also in 2nd Ed., 1945; South Carolina: first observed in 1915). Kadner, 1941, Science, **93**, p. 281 (Southern California). Bunyea and Wehr, 1941, U.S. Dept. Agric., Farmers' Bull. No. **1652** (revised), pp. 56 and 82. Wolcott, 1941, Jl. Agric. Univ.

[52] The pigeon-fly was first mentioned in print by Bernardin de St. Pierre (1773, Voyage à l'Isle de France, à l'Isle de Bourbon, au Cap de Bonne-Espérance, **1**, p. 134). He wrote from Port-Louis, Mauritius: "Je n'oublierai pas un pou fort singulier que j'ai vu s'attacher aux pigeons. Il ressemble au ticq de nos bois, mais la nature lui a donné des ailes. Celui-là est bien destiné aux oiseaux."

Puerto Rico, **25,** pt. 2, p. 121. Bishopp, 1942, U.S. Dept. Agric. Yearbook for 1942, "Keeping Livestock Healthy," pp. 1072–1074, figs. 1–2 (adult; puparium). Essig, 1942, College Entomology, p. 815. J. Bequaert, 1942, Bol. Entom. Venezolana, **1,** No. 4, p. 82; 1943, Bull. Brooklyn Ent. Soc., **37,** (for 1942), pt. 5, p. 185; 1943, Jl. of Parasitology, **29,** p. 131. Hathaway, 1943, Mem. Inst. Osw. Cruz, **38,** pt. 3, p. 413, figs. 1–2 (Brazil: Rio de Janeiro, on domestic pigeon, with 7 Mallophaga, *Columbicola columbae,* carried by 1 fly). Iriarte, 1943, Bol. Lab. Clínica L. Razetti, Caracas, **4,** No. 11, p. 195 (Venezuela: State of Guárico). Barger and Card, 1943, Diseases Parasites Poultry, 3rd Ed., p. 366. (Anonymous), 1943, U.S. Dept. Agric., Insects in Relation to National Defense, Circ. **19,** p. 22, figs. 5–6 (adult, puparium). Benbrook, 1943, in Biester and Devries, Diseases of Poultry, 1st Ed., p. 614, fig. 169. McIndoo, 1943, U.S. Dept. Agric., Bur. Ent. Plant Quar., **E-597,** (mimeographed), p. 16. Snodgrass, 1943, Smithson. Misc. Coll., **104,** No. 1, p. 46, figs. 17*D, E, F* and *I* (mouth-parts); 1944, *Op. cit.,* **104,** No. 7, pp. 79 and 80; figs. 31*D, E, F, I.* Renjifo, 1944, Notas Entomologicas Regionales, p. 24 (Colombia; Buga, Dept. del Valle, on domestic pigeon). Roark, 1945, U.S. Dept. Agric., Bur. Ent. Plant Quar., **E-652,** (mimeographed), p. 27. Herman, 1945, California Fish Game, **31,** pp. 22 and 23.[53] Benbrook, 1945, List Parasites Domesticated Animals North America, 1st Ed., p. 35 (also in 2nd Ed., 1946; and 3rd Ed., 1948). Ditmans, 1945, Amer. Jl. Vet. Res., **6,** p. 239. Roveda and Ringuelet, 1947, Gaceta Veter., Buenos Aires, **9,** No. 46, p. 78 (Argentina). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Mönnig, 1947, Veterinary Helminthology Entomology, 3rd Ed., p. 347, fig. 239. Reyes, 1947, Rev. Grancolombiana Zoot. Hig. Med. Vet., **1,** Nos. 10–12, p. 706 (Colombia); 1948, Rev. Med. Veter., Bogotá, **17,** No. 96, p. 71 (Colombia). MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8,** pt. 4, pp. 426 and 429, fig. 255 (Iowa: Ames. Wisconsin: Madison, Dane Co.; New Holstein. Illinois: Chicago. All on domestic pigeon). Ringuelet, 1948, Publ. Misc. Min. Agric. Argentina, No. **281,** pp. 40 and 54 (Argentina: Cnel. Arnold, Santa Fé; Capital Federal; San Pedro, Buenos Aires; all on domestic pigeon). Benbrook, 1948, in Biester and Schwarte, Diseases of Poultry, 2nd Ed., p. 732, fig. 31.9. Greene, 1949, American Racing Pigeon, **65,** No. 7, p. 9. Hughes, 1949, U.S. Publ. Health Repts., Suppl. **210,** p. 32 (on aircraft). Barger and Card, 1949, Diseases Parasites Poultry, 4th Ed., p. 366, fig. 77. Thompson, 1949, Ent. Mo. Mag., **85,** p. 248 (Jamaica: Long Mountain, St. Andrew, on domestic pigeon). Traversi, 1949, Pampa Argentina, Buenos Aires, **23,** No. 262, p. 24, figs. Rendtorff, Jones and Coatney, 1949, Trans. R. Soc. Trop. Med. Hyg., **43,** No. 1, p. 7 (transmission of *Haemoproteus columbae*). Wray, 1950, Insects North Carolina, 2nd Suppl., p. 33 (North Carolina: Raleigh). Herms, 1950, Medical Entomology, 4th Ed., p. 413. Lastra and Coatney, 1950, Jl. Nation. Malar. Soc., **9,** pt. 2, p. 151 (experiments with *Haemoproteus columbae*). J. Bequaert, 1951, Bull. Brooklyn Ent. Soc., **46,** p. 49 (on aircraft). Wolcott, 1951, Jl. Agric. Univ. Puerto Rico, **32,** (for 1948), pt. 3, p. 531 (Puerto Rico: Yabucoa). Peterson, 1951, Larvae of Insects, **2,** p. 260. Dikmans, Foster, Stein and Giltner, 1952, U.S. Dept. Agric., Yearbook for 1952, "Insects," p. 164. Martini, 1952, Lehrbuch d. Medizinischen Entomologie, 4th Ed., p. 278, fig. 187 (as *P. maura*). Benbrook, 1952, List Parasites Domesticated Animals North America, Revised Ed., p. 52. Coatney and Hickman, 1952, Jl. of Parasitology,

[53] The host of the mites mentioned on p. 23 was *Microlynchia pusilla,* not *P. canariensis* as stated.

38, No. 4, Sect. 2, p. 12 (transmission of *Haemoproteus columbae*). Ward, 1953, Bull. Brooklyn Ent. Soc., **48**, p. 128 (Illinois: Chicago. Phoresy of *Columbicola columbae*). Woke, Jacobs, Jones and Melton, 1953, Jl. of Parasitology, **39**, pp. 525 and 531 (negative transmission experiments with *Toxoplasma gondii*). Schuurmans Stekhoven, 1954, Entom. Ber. Nederl. Entom. Ver., **15**, pt. 2, pp. 24–25 (Argentina: Tucumán. Bionomics). Schuurmans Stekhoven, Silva, and San Roman, 1954, Zeitschr. f. Parasitenk., **16**, pp. 388–406, fig. 1 (bionomics in Argentina).

Pseudolynchia canarensis Giovannoni and de Mello Malheiro, 1952, Rev. Fac. Med. Vet., Univ. São Paulo, **4**, p. 595 (error for *P. canariensis;* no record).

Olfersia testacea Macquart, 1843, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1842), p. 434; Pl. 36, fig. 7 (no sex; no host. Bourbon I. [misspelled "Boubon" = Réunion]. Types at Paris Mus.) [1843, Dipt. Exot., **2**, pt. 3, p. 277; Pl. 36, fig. 7]. Bezzi, 1908, Bull. Soc. Ent. Italiana, **39**, (for 1907), p. 197. Speiser, 1908, Denkschr. Med.-Naturw. Ges. Jena, **13**, pt. 1, p. 178; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 301.

Olfersia garzettae Rondani, 1879, Bull. Soc. Ent. Italiana, **11**, p. 23 (no sex; no host. Italy: Insubria. Type in Natural History Museum at Florence, labelled as from northern Italy).

Lynchia garzettae Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 155. Bezzi, 1905, Kat. Paläarkt. Dipt., **4**, p. 276. Speiser, 1908, Zeitschr. Wiss. Insektenbiol., 4, pp. 244 and 245 (seen from Bavaria). Bau, 1929, Zoolog. Anzeiger, **85**, p. 10 (Greece: Attica).

Olfersia maura Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 237 (no sex; no host. Algeria. Two ♀ cotypes from Bigot Coll., now in J. E. Collin Coll.).

Lynchia maura Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 162 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 245. Bezzi, 1909, Broteria, Ser. Zoolog., **8**, pt. 2, p. 64 (Brazil: São Paulo). Surcouf and Gonzalez-Rincones, 1912, Essai Diptères Vulnérants Vénézuela, **2**, p. 205 (Venezuela: Caracas, on domestic pigeon). Helen Adie, 1915, Indian Jl. Med. Res., **2**, p. 672 (India: Ambala, on domestic pigeon, with Mallophagan attached. Digestive system; transmission of *Haemoproteus columbae*). Knab, 1916, Insecutor Inscitiae Menstruus, **4**, p. 3 (in part: specimens on domestic pigeon. Florida: Key West. Georgia: Savannah, September, 1896. Cuba: Havana. Brazil: Ceará [specimen named "*brunnea*" for da Rocha by Coquillett]; São Paulo; Campinas. Also said to be common at Caracas, Venezuela).[54] Bodkin and Cleare, 1916, Bull. Ent. Res., **7**, pt. 2, p. 187 (British Guiana: common on domestic pigeons). Newstead, 1918, Ann. Trop. Med. Paras., **12**, p. 104, fig. 6 (puparium). Cleare, 1919, Brit. Guiana Med. Annual for 1919, 22nd Year, Demerara, p. 70. Austen, 1921, Bull. Ent. Res., **12**, pt. 1, p. 122 (Jamaica: Spanish Town. Brazil: Pará). Barroso, 1922, Os Parasitas Vegetaes e Animaes, (Bahia), p. 163. Herms, 1923, Medical Veterinary Entomology, 2nd Ed., p. 351. Wolcott, 1924, Jl. Dept. Agric. Puerto Rico, **7**, (for 1923), pt. 1, p. 234 (Puerto Rico). Root, 1925, 13th Ann. Rept. United Fruit Co., Med. Dept., (for 1924), p. 209 (Republic of Honduras: Puerto Arturo near Tela). Jobling, 1926, Parasitology, **18**, pt. 3, p. 321, figs. II*A* and III*A–B;* Pl. 11, figs. 1–9; Pl. 12, figs. 21–26; Pl. 14, figs. 32–43 (anatomy of head, antenna and mouth-parts). Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull. **4**, pts. 1–2, p. 90. Wolcott, 1927, Entomologie d'Haiti, p. 331. Ward and Gallagher, 1927, Diseases Domesticated Ani-

[54] The specimen from Ames, Iowa, referred by Knab to *L. maura* was *Pseudolynchia brunnea.*

mals, p. 213. de Beaurepaire Aragão, 1927, C. R. Soc. Biol., Paris, **97**, pp. 827–829 (transmission experiments with *Haemoproteus columbae* and *Trypanosoma hannai* in Brazil). Barre, 1929, 42nd Ann. Rept. South Carolina Expt. Sta., p. 63 (South Carolina). Hegner, 1929, Animal Parasitology, p. 571, fig. 253. Bishopp, 1929, Jl. Econ. Entom., **18**, pp. 974–980 (Florida: Lockhart. Georgia. South Carolina. North Carolina. Virginia. Maryland. District of Columbia. Alabama. Mississippi. Louisiana. Arkansas. Texas: Dallas. Kansas. Iowa. California. *Haemoproteus columbae* near Washington, D.C. Infested with mites in Florida). Aschner, 1931, Zeitschr. Morph. Oekol. Tiere, **20**, pts. 2–3, pp. 371, 378–380, fig. 1; Pl. 1, fig. 8; Pl. 2, figs. 18–22 (symbionts). Zebrowski, 1932, Audubon Yearbook, Indiana Audubon Soc., p. 48 (also as *Pseudolynchia maura*). Wolcott, 1936, Jl. Agric. Univ. Puerto Rico, **20**, pt. 1, p. 392 (Puerto Rico: Río Piedras: San German; Mayaguez; Coamo). Rivero and Ramirez, 1940, Rev. Inst. Salubr. Enferm. Tropic., Mexico, **1**, p. 247. Neveu-Lemaire, 1943, Traité Protozoologie Médicale Vétérinaire, pp. 451 and 795, figs. 258, 259, and 454. Craig and Faust, 1951, Clinical Parasitology, 5th Ed., p. 722. Dikmans, Foster, Stein and Giltner, 1952, U.S. Dept. Agric., Yearbook for 1952, "Insects," p. 164. Riley and Wallace, 1952, Introduction Study Animal Parasites, 6th Ed., p. 77. Hall, 1953, Protozoology, p. 305, fig. 6.22 (*Haemoproteus columbae*). Reichenow, 1953, in Doflein, Lehrbuch d. Protozoenkunde, 6th Ed., pp. 893–895. Gonzales-Rincones and Guyon, 1953, Clasificación General de los Dípteros, p. 166, fig. 102. Vogelsang, 1953, Deutsch. Tierärztl. Wochenschr., **60**, p. 530 (Venezuela).

Pseudolynchia maura J. Bequaert, 1926, Psyche, **32**, (for 1925), pt. 6, pp. 273 and 276; 1926, Medical Rept. Hamilton Rice 7th Exped. Amazon (1924–25), p. 241. Schuurmans Stekhoven, 1928, Entom. Mitt., Berlin-Dahlem, **17**, p. 443. Bishopp, 1929, Amer. Pigeon Jl., **18**, pp. 419–420, fig. (on p. 420). Drake and Jones, 1930, Iowa State Coll. Jl. Sci., **4**, pt. 2, p. 253; Pl. 1, figs. *a–d* (♂. Iowa: common on domestic pigeons. Ecology; puparium; methods of rearing). Coatney, 1931, Parasitology, **23**, pt. 4, p. 525 (South Carolina: Clemson. Ecology; puparium; methods of breeding). Buckley, Bunyea and Cram, 1931, U.S. Dept. Agric., Farmers' Bull. No. **1652**, pp. 39 and 62. Huff, 1931, Jl. of Parasitology, **31**, p. 122; 1932, Amer. Jl. Hyg., **16**, pp. 618–623 (experimental transmission of *Haemoproteus sacharovi* and *H. maccallumi* from *Zenaidura macroura carolinensis* to domestic pigeon). Beaudette, 1932, 52nd Ann. Rept. New Jersey Agric. Expt. Sta., (for 1930–1931), p. 340 (New Jersey: Union Co., in 1930). Coatney, 1933, Amer. Jl. Hyg., **18**, p. 153 (reared in laboratory on *Zenaidura macroura carolinensis*). Becker, 1933, Amer. Jl. Trop. Med., **13**, p. 516. Prouty and Coatney, 1933, Jl. of Parasitology, **20**, p. 139; 1934, Parasitology, **26**, pt. 2, p. 249 (habits). Martin, 1934, Canad. Entom., **66**, p. 8 (Texas: Houston; with Mallophagan, *Columbicola columbae*, attached). Rawson, 1934, Scientific Monthly, **39**, p. 504. J. Bequaert, 1935, Rev. Zool. Bot. Afric., **27**, pp. 395 and 396, fig. 1*F*. Reis and Nobrega, 1936, Tratado Doenças Aves, p. 382, fig. (on p. 384). Lagos and Canevari, 1937, Rev. Soc. Ent. Argentina, **8**, (for 1936), p. 77; Pl. 7, figs. (Argentina: Buenos Aires). Huff, 1937, in Culture Methods Invertebrate Animals, pp. 446–447 (methods of rearing). Pinto, 1938, Zoo-Parasitos de Interesse Med. Veter., p. 129, figs. 45–46 (Brazil). Barger and Card, 1938, Diseases Parasites Poultry, 2nd Ed., p. 338, fig. 80. Mönnig, 1938, Veterinary Helminthology Entomology, 2nd Ed., p. 332; Pl. 11, fig. 230. Root and Huff, 1938, Parasitology Man Domestic Animals, pp. 279 (wing) and 614. Huff, 1939, Jl. Amer. Vet. Med. Assoc., **94**, p. 619. Buckley, Bunyea and Cram, 1939, U.S. Dept. Agric., Farmers' Bull. No. **1652** (revised), pp. 44 and 67. Hennig, 1941, Arb. Morphol. Taxon. Entom., Berlin-Dahlem, **8**, pt. 4, p. 238, figs. 7–8 (an-

tenna). Huff, 1942, Jl. Infect. Dis., **71,** p. 18 (*Haemoproteus columbae*). Maliandi, 1943, Rev. Med. Vet., Buenos Aires, (Year 28), **25,** pts. 3–4, pp. 128, 131 (fig.), 132 (fig.) and 133 (fig.). de Sequeira, 1944, Chacaras e Quintais, **69,** p. 357. Loria, 1944, Suelo Argentino, **3,** p. 299; 1944, Almanaque Min. Agric. Nac. Argentina, **19,** pp. 209–211. de Figueredo and Simões Barbosa, 1944, Anais Soc. Biol. Pernambuco, **5,** pt. 1, pp. 15–16, figs. 1–4 (Brazil: Recife, State Pernambuco. Infestation with mites, *Myialges pseudolinchiae*). Seiden, 1947, Poultry Handbook, pp. 281 and 283 (same in 2nd Ed., 1952). Becker, 1948, in Biester and Schwarte, Diseases of Poultry, 2nd Ed., p. 922. Cassamagnaghi, 1950, Bol. Mens. Dir. Ganadería, Uruguay, 31, pt. 3, p. 374, figs. 5–6 (Uruguay). Kaupp and Surface, 1950, Poultry Sanitation Disease Control, 4th Ed., p. 164. Hennig, 1952, Larvenformen der Dipteren, **3,** pp. 401–402, fig. 301 (larval stigmal plates). Correa, 1952, Bol. Dir. Prod. Anim., Rio Grande do Sul, **8,** No. 13, p. 6; Pl., fig. 3 (Brazil: Rio Grande do Sul).

Olfersia lividicolor Bigot, 1885, Ann. Soc. Ent. France, (6), **5,** p. 238 (no sex; no host. Brazil. Type ♀ from Bigot Coll., now in J.E. Collin Coll.).

Lynchia lividicolor Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2,** p. 164 (type); 1903, Centralbl. Bakt. Parasit., Abt. 1, Orig., **33,** p. 610 (Brazil: on domestic pigeon); 1908, Zeitschr. Wiss. Insektenbiol., **4,** p. 304 (said to be possibly identical with *maura* Bigot). Lutz, Neiva, and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7,** pp. 185, 191 and 194; Pl. 27, fig. 10, Pl. 28, fig. 5 (Brazil: common on domestic pigeons). de Beaurepaire-Aragão, 1916, Brazil-Medico, **30,** pp. 353 and 361 (transmission of *Haemoproteus columbae* in Brazil). Lutz and Nuñes-Továr, 1928, Estudios Zoología Parasitología Venezolanas, p. 9 (Venezuela: on domestic pigeon). Vogelsang, 1936, Rev. de la Policlinica, Caracas, **6,** No. 31, p. 2.123 (Venezuela: Maracay, on domestic pigeon). Carbonell, 1938, Parasitología en Venezuela y los Trabajos del Dr. M. Nuñez-Továr, p. 250. Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 982; 1943, Traité Protozoologie Médicale Vétérinaire, pp. 451 and 795.

Lynchia maura var. *lividicolor* Martorell, 1939, Jl. Agric. Univ. Puerto Rico, **23,** p. 221 (Venezuela: State Aragua, on domestic pigeon).

Pseudolynchia maura var. *lividicolor* J. Bequaert, 1926, Psyche, **32,** (for 1925), pt. 6, p. 274.

Lynchia "brunea or *lividicolor"* de Beaurepaire Aragão, 1907, Brazil-Medico, **21,** No. 15, pp. 141–142; No. 31, pp. 301–303, 2 Pls. [reprint: 1907, Rio de Janeiro, 17 pp., 2 Pls.] (transmission of *Haemoproteus columbae* in Brazil); 1908, Rev. Medica São Paulo, **11,** p. 416; 1908, Arch. f. Protistenk., **12,** p. 155 (Brazil: Rio de Janeiro, on domestic pigeon. Transmission of *Haemoproteus columbae* in Brazil).

Lynchia brunea lividocolor Patton and Cragg, 1913, Textbook Medical Entomology, p. 407 (Brazil).

Lynchia lividiccla R. v. Ihering, 1940, Da vida dos Nossos Animais, Fauna do Brasil, 2nd Ed., p. 247, fig. 504 [1st Ed., 1917, not seen]; (error for *lividicolor*).

Olfersia capensis Bigot, 1885, Ann. Soc. Ent. France, (6), **5,** p. 240 (♂; no host. South Africa: Cape of Good Hope. Type ♂ in J. E. Collin Coll.).

Lynchia capensis Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2,** p. 166 (type, redescribed); 1908, Zeitschr. Wiss. Insektenbiol., **4,** pp. 245 and 246 (seen from Canary Ids.). Ward and Gallagher, 1927, Diseases Domesticated Animals, p. 213. Neveu-Lemaire, 1943, Traité Protozoologie Médicale Vétérinaire, pp. 451 and 795.

Pseudolynchia capensis Root and Huff, 1938, Parasitology Man Domestic Animals, p. 614.

Olfersia falcinelli Bezzi and de Stefani-Perez, 1897, Naturalista Siciliano, (N. S.), **2,** p. 71 (Sicily, on domestic pigeon). de Stefani-Perez, 1901, Boll.

Natur. Coll. Siena, **20,** p. 79. Not of Rondani, 1879. (See Speiser, 1903, Centralbl. Bakt. Parasit., Abt. 1, **33,** Orig., p. 609; 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41,** p. 336).

Olfersia exornata Speiser, 1900, Ann. Mus. Civ. Stor. Nat. Genova, **40,** p. 562 (no sex; no host. West Sumatra: Doloc Tolong. Type ♀ in Genoa Mus.).

Lynchia exornata Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2,** p. 155; 1908, Zeitschr. Wiss. Insektenbiol., **4,** p. 244 and 302 (said to occur also in Palearctic Region).

O[lfersia] exonorata "Speiser" Thompson, 1936, Ann. Mag. Nat. Hist., (10), **18,** p. 316, footnote (misspelling of *O. exornata*).

Lynchia simillima Speiser, 1904, Ann. Mus. Civ. Stor. Nat. Genova, **41,** p. 337 (no sex; no host. Java: based on the specimen called "*Olfersia spinifera*" by van der Wulp, 1880, Tijdschr. v. Entom., **23,** p. 193. Type from J.C.H. de Meijere Coll., now in the collection of the Nederlandsche Entom. Vereeniging, Amsterdam); 1908, Zeitschr. Wiss. Insektenbiol., **4,** p. 302.

Lynchia brunnea Coquillett, 1907, Ent. News, **18,** p. 290. Dias da Rocha, 1908, Bol. Muzeu Rocha, Ceará, **1,** pt. 1, p. 77 (Brazil: Ceará; specimen named "*brunnea*" by Coquillett, which I found to be *canariensis*). Essig, 1926, Insects Western North America, p. 623 (California: San Diego, on domestic pigeon). Not of Latreille, 1812.

Pseudolynchia brunnea Root and Huff, 1938, Parasitology Man Domestic Animals, p. 614. Not of Latreille, 1812.

Lynchia brunea Mayo, 1909, 2nd Ann. Rept. Cuba Agric. Expt. Sta., p. 27 (Cuba: on domestic pigeon). Neveu-Lemaire, 1943, Traité Protozoologie Médicale Vétérinaire, pp. 451 and 795.

Pseudolynchia mauza Schuurmans Stekhoven, 1931, Lingnan Sci. Jl., **7,** (for 1929), p. 501 (error for *maura*).

Pseudolynchia or *Lynchia* sp. Rivero, 1947, Medicina, Mexico, **27,** pp. 197 and 199.

Lynchia carolinensis Reichenow, 1953, in Doflein, Lehrbuch d. Protozoenkunde, 6th Ed., p. 894 (error for *L. canariensis*).

The following references use only the vernacular name "pigeon-fly:" S.L.R., 1922, Amer. Pigeon Jl., **11,** p. 335 (Panama: common on domestic pigeon in Canal Zone). Gilbert, 1922, *Op. cit.,* **11,** p. 383 (Florida: Jacksonville). Houbrich, 1922, *Op. cit.,* **11,** p. 383 (Panama: France Field, C.Z.). Bishopp, 1929, *Op. cit.,* **18,** p. 517 (methods of control). Fung, 1930, *Op. cit.,* **19,** p. 259 (control). Levi, 1930, *Op. cit.,* **19,** pp. 270 and 319 (control). Haynes, 1944, Practical Pigeon Production, p. 211. Levi, 1946, Making Pigeons Pay, p. 224.[55]

Distribution and Specimens Examined. UNITED STATES. ALABAMA (recorded by Bishopp, 1929): Birmingham, Jefferson Co. (J.M. Lowrey); Montgomery, Montgomery Co. (M.J. Myers); Auburn, Lee Co. (A.O. Haugen). — ARKANSAS (recorded by Bishopp, 1929): Little Rock, Pulaski Co. (W.J. Baerg). — CALIFORNIA (recorded by Essig, 1926; Bishopp, 1929; Kadner, 1941):

[55] Vogl, 1944, Bol. Soc. Venezolana Cienc. Natur., **9,** No. 60, p. 323, lists several localities in Venezuela where he supposedly collected "*Lynchia lividicola,*" in the feathers of Falconidae, Vulturidae, Strigidae, "sobre huevos de zamuros," and some aquatic birds. As several distinct species of Hippoboscidae were evidently confused, it is impossible to use the records.

San Bernardino Co. (C. Meith); Compton, Los Angeles Co. (T. Leuder); Tarzana, Los Angeles Co. (A.M. Hill); Westwood Hills, Los Angeles Co. (R.S. Pence); Los Angeles (J. Posell; B. Turner); Loma Linda, San Bernardino Co. (R.E. Ryckman, *et al.*); San Diego, San Diego Co. (E.O. Essig); Santa Ana, Orange Co. (J. Shanafelt); Oxnard, Ventura Co. (Calif. Dept. Agric.); Point Loma, San Diego Co. (F.C. Bishopp). — Colorado: Denver, Denver Co. (F.R. Dutton). — Connecticut: Stamford, Fairfield Co. (Grierson and van Dusen). — Delaware: Newark, New Castle Co. (D. MacCreary). — District of Columbia (recorded by Bishopp, 1929): seen (F.C. Bishopp). — Florida (recorded by Knab, 1916; Gilbert, 1922; Bishopp, 1929): Monticello, Jefferson Co. (F.W. Walker); Gainesville, Alachua Co. (T.J. Cantrall); Jacksonville, Duval Co. (E.C. Cushing; K.W. MacArthur; E. Basham); Delray Beach, Palm Beach Co. (C.W. Johnson; C.G. Huff); Miami, Dade Co. (J.M. Brian), and 5 flies intercepted on 4 planes arriving from Brazil, Trinidad and India (W.W. Wirth. — See J. Bequaert, 1951*b*); Longwood, Seminole Co. (W.L.G. Bruce); Lockart, Orange Co. (F.C. Bishopp); Homestead, Dade Co.; Pensacola, Escambia Co. (F.C. Bishopp); Key West, Monroe Co. (J.Y. Porter); Orlando, Orange Co. (W.W. Yothers); Larkins, Dade Co. (S. Graenicher). — Georgia (recorded by Knab, 1916; Bishopp, 1929): [Perry, Houston Co.; Augusta, Richmond Co. — P.W. Fattig, *in litt.;* not seen]; Savannah, Chatham Co. (W. Duncan); Atlanta, Fulton Co. (P.W. Fattig; J. R. Harber; L. Brown); Bainbridge, Decatur Co., on poultry (R.H. Herron); Macon, Bibb Co. (F.C. Bishopp). — Illinois (recorded by MacArthur, 1948; Ward, 1953): Chicago (A.K. Wyatt). — Iowa (recorded by Bishopp, 1929; Drake and Jones, 1930; Coatney, 1933; MacArthur, 1948): Ames, Story Co. (T.M. Harris); Des Moines, Polk Co.[56] — Kansas (recorded by Bishopp, 1929): Arkansas City, Cowley Co. (G.C. Abelson). — Louisiana (recorded by Bishopp, 1929): Lutcher, St. James Parish (Cox. — Received from E.B. Johnson); Houma, Terrebonne Parish (W.A. Douglas); Lafayette, Lafayette Parish (C. Gary); Baton Rouge, East Baton Rouge Parish (F.C. Bishopp; W.W. Wirth; J.H. Roberts); New Orleans (T.E. Snyder). — Maryland (recorded by Bishopp, 1929): Bethesda, Montgomery Co., at Trop. Dis. Lab. (P.A. Woke). — Massachusetts: Cambridge, Middlesex Co., Oct. 1932, Dec. 1941, and June 1942 (R.P. Dow; D.R. Griffin and

[56] The fly recorded by Knab (1916) from Iowa as "*Lynchia maura*" was *P. brunnea,* according to the specimen; but I have seen true *P. canariensis* from Ames and Des Moines.

G. Bartholomew); Boston, about 1940 (D.L. Augustine), Dec 21, 1952, one ♀ flying from a dead feral pigeon onto a person (received from G.E. Wallace), and May 6, 1954, on a pigeon kept in a laboratory (A.G. Humes). — Mississippi (recorded by Bishopp, 1929): Jackson, Hinds Co. (Mrs. J.V. Bogert); Hattiesburg, Forrest Co. (E. Cook); Macon, Noxubee Co. (J.V. Pace); McComb, Pike Co. (D.M. Williams); Terry, Hinds Co. (O.M. Chance); Laurel, Jones Co. (C.G. Wallace); Meridian, Lauderdale Co. (F. Ziller); Natchez, Adams Co. (F.C. Bishopp). — Nevada: Las Vegas, Clark Co. (W.B. Low). — New Jersey (recorded by Beaudette, 1932): Bloomfield, Essex Co. (J.N. Belkin). — New York: New York City, Oct. 1922 (J. Bequaert), and Sept. 1951 (J.W.H. Rehn). — North Carolina (recorded by Bishopp, 1929; Wray, 1950): Raleigh, Wake Co. (R.M. Brown; Mrs. R.C. Simpson). — Pennsylvania: Pittsburgh, several adults in a pigeon loft, Oct. 1948 (G.E. Wallace). — South Carolina (recorded by Barre, 1929; Bishopp, 1929; Coatney, 1931): Columbia, Richland Co.; Sumter, Sumter Co. (H. Moise; E.E. Wehr); Charleston, Charleston Co. (J.T. Rogers). — Tennessee: Nashville, Davidson Co., July 18, 1955, on feral domestic pigeon (Mrs. A.R. Laskey); Knoxville, Knox Co. (A.C. Cole). — Texas (recorded by Bishopp, 1929; Martin, 1934): San Antonio, Bexar Co. (B. Weir); Houston (C.P. Coogle); Corpus Christi, Nueces Co. (W.M. Gordon); Port Arthur, Jefferson Co. (J. Johnston); Santa Anna, Coleman Co. (O.R. Brown); Dallas, Dallas Co. (F.C. Bishopp). — Virginia (recorded by Bishopp, 1929): Cape Henry, Princess Anne Co. (E.A. Chapin). — Wisconsin (recorded by MacArthur, 1948): Madison, Dane Co. (F. Snyder).

Mexico: [Chapultepec, D.F., on domestic pigeon. — Mrs. Ana María de Buen de Biagi, *in litt.*, Aug. 30, 1950; not seen]; Mexico City, D.F. (G. Lasmann; Esc.N.C.Biol.); Tampico, State Tamaulipas (W. Garza).

Republic of Honduras (recorded by Root, 1925): Puerto Arturo near Tela (F.M. Root).

Costa Rica: San José (H. Schmidt).

Panama (recorded by S.L.R., 1922; Houbrich, 1922): Ancon, C.Z. (L.H. Dunn).

Antilles. Cuba (recorded by Mayo, 1909; Knab, 1916): Punta de Guano, Prov. Matanzas (F. Bermudez); Vedado, Havana (J.R. Taylor); Matanzas, Prov. Matanzas (C. Sanchez); Baragua, Prov. Oriente (L.C. Scaramuzza); San Antonio de los Baños, Prov. Havana (P. Cardin); Cienfuegos, Prov. Las Villas (P. Cardin). — Jamaica (recorded by Austen, 1921; Gowdey, 1926; Thompson,

1949): Kingston (W. Buthner; R.P. Bengry). — Hispaniola: Port-au-Prince, Haiti (C. Lhérisson; R.C. Smith.) — Puerto Rico (recorded by Wolcott, 1924, 1936, 1951): Yabucoa (L. Martorell); Mayagüez (H.L. Dozier; H.L. Van Volkenberg). — St. Croix: seen from domestic pigeon (H.A. Beatty).[57] — St. Kitts: (Branch). — Barbados (G.S. Evelyn).

Colombia (recorded by Renjifo, 1944; Reyes, 1947, 1948): Bogotá (E. Osorno); Baranquilla, Dept. Atlantico (E. Osorno); Cali, Dept. Valle del Cauca (S. Renjifo-Salcedo); Palmira, Dept. Valle del Cauca (Newball); Cartagena (A. Paz Arriaga).

Venezuela (recorded by Surcouf and Gonzalez-Rincones, 1912, as *L. maura;* Knab, 1916, as *L. maura;* Lutz and Nuñes-Továr, 1928, as *L. lividicolor;* Vogelsang, 1936, as *L. lividicolor,* 1953, as *L. maura;* Martorell, 1939, as *L. maura* var. *lividicolor;* Iriarte, 1943): Hacienda Tazon near Caracas (D.R. Iriarte).

Trinidad: Port of Spain (R.C. Shannon).

British Guiana (recorded by Bodkin and Cleare, 1916, as *L. maura*): without precise locality (A.A. Abraham); Georgetown (J. Rodway).

Brazil (recorded by Bigot, 1885, as *L. lividicolor;* Speiser, 1903, as *L. lividicolor;* Aragão, 1907, as *L. brunea* or *L. lividicolor;* Dias da Rocha, 1908, as *L. brunnea;* Bezzi, 1909, as *L. maura;* Lutz, Neiva and da Costa Lima, 1915, as *L. lividicolor;* Knab, 1916, as *L. maura;* Austen, 1921, as *L. maura;* Pinto, 1938, as *P. maura;* Hathaway, 1943; de Figueredo and Simões Barbosa, 1944, as *P. maura;* Corrêa, 1952, as *P. maura*): Rio de Janeiro, D.F. (L.C. Ferreira); Itaquaquecetuba, State São Paulo (C.H.T. Townsend); City of São Paulo (Ad. Lutz); Manáos, State Amazonas (J. Bequaert); Ypiranga, State São Paulo (J. Lane); Manguinhos, Rio de Janeiro, D.F. (Inst.Osw.Cruz); Vicosa, State Minas Gerais; Ceará (F. Dias da Rocha); Campinas, State São Paulo (A. Hempel; G. Bouvier); Kilom. 47 on road of Rio de Janeiro to São Paulo (C.H.T. Townsend).

Peru: Trujillo (J. Ormea).

Uruguay (recorded by Cassamagnaghi, 1950): Montevideo (Parker; L.P. Barattini).

---

[57] The flies reported as *P. canariensis* from St. Croix, on a wild pigeon (*Colombigallina passerina brevirostris,* by H.A. Beatty (1947, p. 154), were misidentified *Microlynchia pusilla.* I have seen the specimens caught by Beatty on this host, at the U. S. National Museum, where they had been placed by error under *P. canariensis.*

Argentina (recorded by Lagos and Canevari, 1937; Roveda and Ringuelet, 1947; Ringuelet, 1948; Schuurmans Stekhoven, 1954; Schuurmans Stekhoven, Silva and San Ramon, 1954): Tucumán (R. Golbach).

Unless expressly stated otherwise, the American records are from introduced domestic or rock pigeon, *Columba l. livia*. The fly is known to occur, at least during the summer, on pigeons gone feral in the United States at Boston, Cambridge, Mass., New York, Chicago and Nashville, and in Argentina at Tucumán. It probably does so in many other American cities.

P. canariensis was originally a native of the tropical and subtropical parts of the Old World, where it breeds regularly on several wild species of Columbidae and possibly also on some other types of birds. It is particularly widespread in Africa, the countries bordering the Mediterranean to the north, southern Asia and Indonesia. Farther north in Europe it is only accidental on wild hosts and does not occur regularly on domestic pigeons. In the Old World it is definitely known as a parasite of domestic pigeon in Portugal, Spain, southern France (Lyons), Italy, Sicily, Greece, Roumania, the Canary Islands, Morocco, Algeria, Tunis, Cyrenaica, Egypt, Senegal, the central Sahara (Hoggar), the eastern Sudan, Eritrea, Portuguese Guinea, Dahomey, French Congo, Belgian Congo, Ruanda-Urundi, Tanganyika, Zanzibar I., Somaliland, Eritrea, Northern Rhodesia, Southern Rhodesia, Nyasaland, South West Africa, Cape Province, Transvaal, Natal, Madagascar, Reunion, Mauritius, Seychelles, Cyprus, Palestine, Iraq, Arabia, India, Ceylon, southern China (Canton; Honan I.), Philippines, Sumatra, Java, Australia, Tasmania, and Hawaii. In addition there are records on wild hosts from France, Morocco, Liberia, Northern Nigeria, eastern Sudan, Arabia, Tanganyika, Uganda, Northern Rhodesia, Southern Rhodesia, Nyasaland, Cape Province, Cyprus, Afghanistan, India, Nepal, Thailand (Siam), Philippines, and southern Japan (Okinawa). The occurrences on wild hosts probably delimit the original home or autochthonous habitat of the species. The northmost records are from France: Paris, in the Jardin des Plantes, host unknown; Ushant I., about 48° 28′ N., on turtle dove, *Streptopelia t. turtur;* Vitry-sur-Seine, about 48° 49′ N., on domestic pigeon (Villeneuve, 1913, p. 131); and Moret, Dept. Seine-et-Marne, about 48° 22′ N., on domestic pigeon (Séguy, 1932*a*). Speiser (1908) reported a specimen from Bavaria.

In the New World *P. canariensis* appears to be a comparatively recent arrival. It was first reported in 1885, when Bigot described

his *Olfersia lividicolor* (a synonym of *canariensis*) from Brazil; but it may have occurred in America many years before it was noticed by entomologists. The earliest reported occurrence in North America was from Savannah, Georgia, in 1896 (Knab, 1916). No specimen has been taken as yet in the Dominion of Canada. In the United States it occurs occasionally as far north as Ames, Chicago, Madison and Boston, all localities in about the same latitude (42° to 43° N.); therefore not as far north as in Western Europe. Moreover, it is doubtful whether it can survive severe winters north of Maryland and Kansas (J. Bequaert, 1943*b*). It is now reported from most of the Antilles, Central and South America, with the exceptions of Guatemala, San Salvador, Nicaragua, Dutch Guiana, French Guiana, Bolivia, Paraguay and Chile, where no doubt it will be found when looked for. The southmost localities known are Tucumán (26° 50′ S.), where it is common, and Montevideo (34° 55′ S.).

Bionomics. In the New World *P. canariensis* is strictly a parasite of domestic pigeons. There is no reliable evidence that it ever strays to any native American bird in nature; but there is one record from domestic poultry in Georgia. Coatney (1931) kept it alive for 15 days on domestic chickens, obtaining meanwhile normal puparia which produced adult flies. Coatney (1931, 1933) and Huff (1932) also induced the fly to bite and feed on native doves, *Zenaidura macroura carolinensis,* in the laboratory. It flies often onto Man and will bite him sometimes spontaneously.

In the Old World the fly has been taken in nature on the following wild hosts. Ciconiiformes: *Hagedashia hagedash niloticus.* Falconiformes: *Accipiter badius dussumieri; A. n. nisus; A. nisus nisosimilis; Aquila rapax raptor; Buteo v. vulpinus; Circaëtus g. gallicus; Circus macrourus; Falco amurensis; F. ardosiaceus; F. biarmicus erlangeri; F. eleonorae; F. t. tinnunculus; Gymnogenys t. typicus; Haliaeëtus v. vocifer; Kaupifalco m. monogrammicus; Lophaëtus occipitalis; Meliërax gabar; M. m. musicus; M. musicus theresae; Milvus migrans parasitus; Neophron percnopterus ginginianus; Polihiërax s. semitorquatus; Spizaëtus c. cirrhatus.* Galliformes: *Numida m. meleagris; N. meleagris somaliensis; Pternistis afer nyanzae; P. l. leucoscepus.* Columbiformes: *Columba livia intermedia; C. p. palumbus; C. rupestris turkestanica; Pterocles lichtensteini arabicus; P. q. quadricinctus; P. quadricinctus lowei; Streptopelia bitorquata dusumieri; S. capicola tropica; S. chinensis tigrina; S. d. decaocto; S. decipiens permista; S. r. roseogrisea; S. semitorquata erythrophrys; S. t. turtur; Treron calva schalowi;*

Turtur a. afer. Cuculiformes: *Clamator cafer; Crinifer africanus zonurus; C. leucogaster; C. personatus leopoldi; Cuculus c. canorus.* Strigiformes: *Asio c. capensis; Athene b. brama; Bubo b. bubo; Ketupa z. zeylonensis; Otus l. leucotis; Tyto alba affinis.* Coraciiformes: *Coracias g. garrulus; C. n. noevia; C. noevia mosambica.* Passeriformes: *Cinclus pallasii tenuirostris; Corvus albus; Galerida theklae ellioti; Temenuchus pagodarum.*[58] Although this is a long list, it is based on too few individual verified records for a full understanding of the relations of the fly with its wild hosts in nature. It is evident that various wild Columbidae are effective breeding hosts, so that the parasite of the domestic pigeon was obviously retained from the wild stock of the rock dove, *Columba livia* (Part I, p. 296). Whether or not the species could maintain itself on diurnal birds of prey, in the absence of Columbidae, remains, however, a moot question, in spite of its frequent occurrence on such birds. It should be kept in mind that many Raptores prey regularly on wild and domestic pigeons, from which they no doubt often acquire pigeon-flies, but perhaps only for a short time. The few occurrences on birds of other orders are probably all due to accidental or temporary straying.

I reviewed in Part I most of the available information on symbiotic micro-organisms (pp. 101 and 103), destruction by the host (p. 129), transmission of *Haemoproteus* to pigeons (pp. 138–139 and 354–358), parasitism by mites (pp. 145–146 and 158–159) and chalcids (p. 161), phoresy of Mallophaga (p. 173), sex ratio (p. 178), maturation period (p. 180), mating (pp. 182–183), larviposition (pp. 193–194), duration of pupal development (p. 199), adult longevity (pp. 203–204), rate of reproduction (pp. 207–208), population dynamics (p. 233), settling of new hosts (pp. 244–245), host specificity in domestication and in nature (pp. 295–296 and 323), and effect of the bite on Man (p. 345). More recent observations on some of these topics are summarized presently.

Through the courtesy of Dr. J.H. Schuurmans Stekhoven, Jr., I was able to mention briefly in Part I the important observations made by him and his associates in Argentina. These have now been published in two papers, one by Schuurmans Stekhoven (1954*a*) and the other by Schuurmans Stekhoven, Silva and San

[58] *Caprimulgus europaeus* is omitted from this host list, because the record of *Pseudolynchia maura* from this bird by Gil Collado (1937, p. 2061; 1947, p. 220), at Teruel, Spain, may have been due to failure to recognize *P. rufipes*, which I have seen from this host.

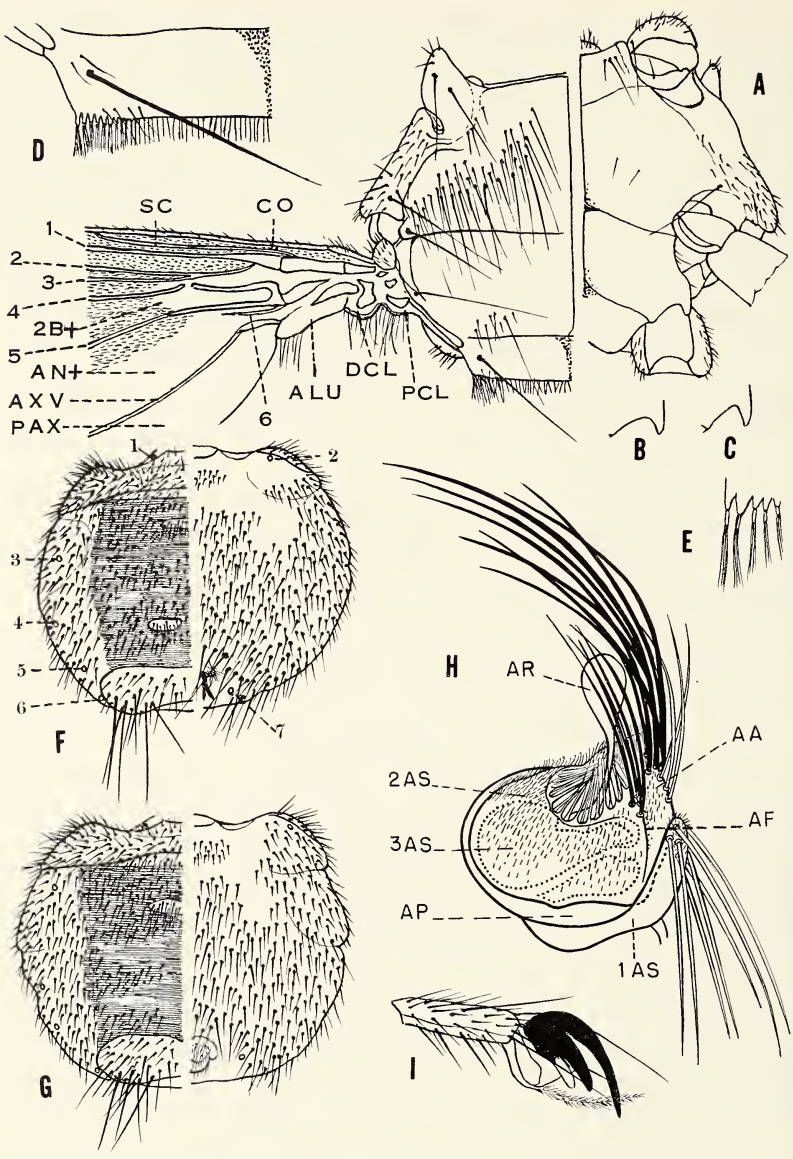

Fig. 78. *Pseudolynchia canariensis* (Macquart). **A**, thorax dorsally and ventrally, and basal area of left wing, ♀, Nashville, Tenn.: *ALU*, alula; *AN+*, combined anal, 3rd posterior and axillary cells; *AXV*, axillary vein; *2B+*, combined 2nd basal and 2nd posterior cells; *CO*, costa; *DCL*, upper calyp-

Ramon (1954); a third paper is to appear shortly. These should be consulted for many additional details. The second paper covers the density and frequency of infestation on adult pigeons and on squabs in the nest (pp. 390–391), the sex ratio of flies found on pigeons and bred from puparia (pp. 394–395), the resistance to starvation of adult flies (pp. 396–399), the feeding behavior (pp. 400–403), and parasitism by mites and by chalcids (p. 404).

According to the latest information available, the correct name of the chalcid parasite, bred at Tucumán from puparia of *P. canariensis,* is *Nasonia vitripennis* (Walker) (synonyms: *Pteromalus vitripennis* Walker, 1836; *Pteromalus abnormis* Boheman, 1858; *Mormoniella brevicornis* Ashmead, 1904; *Nasonia brevicornis* Ashmead, 1904), and not *Mormoniella vitripennis* as given in Part I (p. 161). *Mormoniella* and *Nasonia* are synonyms, being based on the same species. Although *Mormoniella* has page precedence, *Nasonia* should be used, as it was preferred by the first reviser. (See Peck, 1951, in Muesebeck *et al.*, Hymenoptera of America North of Mexico, Synoptic Catalog, *U.S. Dept. Agric., Agric. Monogr.* No. **2**, p. 559).

The following cases of infestation with mites may be added to the list:

9. Of 6 flies from domestic pigeon at Gainesville, Fla., 2 ♀ carried mite clusters on the sides of the dorsum of the abdomen, 3 in one case, 1 in the other.

10. A ♀ from Tampico, Mexico, on domestic pigeon, carried a small mite cluster dorsally on each side of the abdomen.

Concerning the mites of the pigeon-fly, it may be noted that both the generic and trivial names of *Myialges anchora* should be credited to Trouessart only, and not to Sergent and Trouessart, as was done in Part I. Trouessart alone first published them with a brief diagnosis of the mite in 1906 (date given on the wrapper of pt. 5 of vol. **31** of *Bull. Soc. Zool. France,* where the description is on pp. 128–129) or early in 1907. Attention is also called to a recent discussion of *Myialges* by Furman and Tarshis (1953).

---

ter; *PAX,* postaxillary cell; *PCL,* lower calypter; *SC,* subcosta; *1, 2, 3, 4, 5,* and *6,* 1st, 2nd, 3rd, 4th, 5th, and 6th longitudinal veins; **B,** mesosternal spur, ♀, St. Kitts; **C,** mesosternal spur, ♀, Luputa, Belgian Congo; **D,** left half of scutellum, and **E,** digitations at outer angle of scutellum, ♀, Djakarta, Java; **F,** abdomen dorsally and ventrally, ♂, Costa Rica, abdominal spiracles numbered 1 to 7; **G,** abdomen dorsally and ventrally, ♀, Nashville, Tenn.; **H,** left antenna from the side, after Jobling (1926): *AA,* antennal appendage; *AF,* antennal furrow; *AP,* antennal pit; *AR,* arista of 3rd segment; *1AS, 2AS,* and *3AS,* 1st, 2nd, and (hidden) 3rd antennal segments; **I,** distitarsus and claw of hind leg, ♀, Nashville, Tenn. All from domestic pigeon.

An additional case of phoresy of the pigeon-louse, *Columbicola columbae,* was observed in Chicago by R.A. Ward (1953). Brief mention should also be made of Hiragaudar and Khambata's (1954) observation of a *P. canariensis* (reported as *P. maura*) carrying in India a louse of a species of *Brüelia* said to occur normally on Corvidae.

Woke, Jacobs, Jones and Melton (1953) were unsuccessful in experiments to transmit toxoplasmosis of vertebrates, caused by *Toxoplasma gondii* Nicolle and Manceaux, by the bite of *P. canariensis.*

The puparium is easily obtained by keeping pigeon-flies on domestic pigeons in appropriate cages (Huff, 1937). It was first described by Edm. and Et. Sergent (1907, p. 265, figs. 4–5) and was also mentioned or figured by Helen Adie (1915, p. 672), Drake and Jones (1930, p. 253; Pl. 1, fig. *d*), Coatney (1931, p. 525), and Bishopp (1942, p. 1074, fig. 2). The following description is based on specimens bred in the Belgian Congo, from flies kept on domestic pigeons, by Dr. J. Rodhain (at Boma) and by Dr. G. Bouvier (at Luputa). The normally developed puparium (Figs. 79*C–E*) is almost regularly, but broadly elliptical from above, scarcely narrower posteriorly, moderately depressed and almost equally convex dorsally and ventrally, 3 to 3.4 mm. long, 2.4 to 2.8 mm. wide and 1.8 to 2 mm. thick. The polypneustic lobes were described by Newstead (1918, p. 104, fig. 6) from a young adult larva; in a fully-formed puparium they form an almost uniformly convex cap, without indication of radiating ridges or interspaced depressions; the cap is barely hexagonal because of 6 slight sinuosities (much shallower than figured by Newstead for the larva), one dorsal, one ventral and 2 on each side. The apex is not appreciably sunken, but bears a median elongate pit and on each side the minute spiracular scar of an earlier larval instar in a very slight depression. (Newstead regards these 2 scars as the single pair of abdominal or anal stigmata and the pores on the polypneustic lobes as "supernumerary stigmata." I am unable to agree with this interpretation.) On the cap itself the minute spiracular pores are arranged in the usual 6 groups, 3 on each lateral half of the cap, each group corresponding to one of the six "slits" on the two stigmal plates of the higher Muscoidea. In *P. canariensis* a single group comprises from 10 to 15 pores, widely spaced, but mostly situated toward the periphery of the cap in an irregular curve. Each pore is set in the center of a small, slightly raised, flat area. The

remainder of the cap is uniformly covered with minute punctures. The surface of the puparium itself is bare, moderately shiny and covered with a microscopic network of very fine engraved lines. I can find no trace of transverse segmentation nor of longitudinal depressions at the sides.

Affinities. As noted elsewhere (1938*d*, p. 43; Part I, p. 296), *P. canariensis* varies greatly in size and tends to average larger on domesticated pigeons than on wild hosts; but some specimens from either type of host are about the same size. On domestic pigeons the wing is 5.8 to 7.5 mm. long (average 6 to 6.5 mm.) and on wild hosts, 4.5 to 6 mm. (average about 5 mm.).

P. canariensis and the Old World *P. rufipes* are so closely related that I am not yet fully satisfied of their specific distinctness. They seem to differ consistently in the shape of the undivided, basal portion of the interantennal area of the frons, which in *rufipes* is much narrower than its shortest distance from an eye and slightly narrower than an antennal pit; whereas in *canariensis* it is about as wide as its shortest distance from an eye and as wide as an antennal pit or wider. There appears to be also a slight difference in the relative length of the 1st and 2nd antennal segments, but it is too subtle to be of much help in diagnosis. The two species are difficult to separate except by direct comparison of specimens and this cannot be done properly from slide mounts. In my earlier papers (1935*a*, p. 396; 1938*d*, p. 43) I mentioned that in *rufipes* the interocular face seemed more nearly parallel-sided, the postvertex slightly longer in proportion to its width, the humeral callosity shorter and broader, and the scutellum relatively narrower and longer than in *canariensis;* but a study of extensive series of flies from domestic pigeons has shown that these differences are too variable to be trusted.

The number, size and shape of the tufted, finger-shaped protuberances at the outer corners of the scutellum (Figs. 78*D–E*) vary greatly in *canariensis* and its 2 congeners, so that it is impossible to use them as specific characters.

In the wing, the bare area in the combined anal, 3rd posterior and axillary cells varies greatly in extent, covering posteriorly from about $\frac{1}{3}$ to $\frac{1}{2}$ of the cell. In addition, there is a longitudinal, discal bare streak, very variable in length and width (usually from $\frac{1}{5}$ to $\frac{1}{3}$ of the width of the cell, occasionally less than $\frac{1}{5}$), in the combined 2nd basal and 2nd posterior cells, as well as a narrow bare streak along the apical portion of the 3rd longitudinal vein in the 1st posterior cell. The apex of the marginal and of

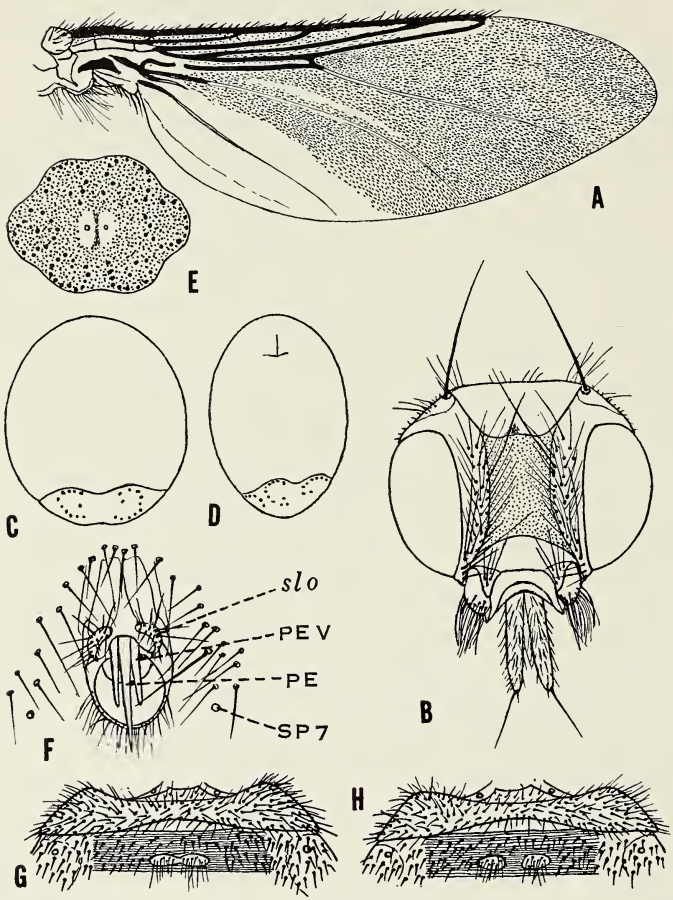

Fig. 79. *Pseudolynchia canariensis* (Macquart). **A**, wing, ♀, Djakarta, Java; **B**, head, ♀, Baragua, Cuba; **C–E**, puparium, Luputa, Belgian Congo, from above (**C**), in side view (**D**), and respiratory lobes (**E**); **F**, ♂ terminalia, Costa Rica: *PE*, penis; *PEV*, penis valves; *slo*, setigerous lobes at side of genital atrium; *SP7*, 7th abdominal spiracle; **G–H**, dorsal basal area of abdomen, ♀: **G**, San Antonio, Tex.; **H**, New York City. All from domestic pigeon.

the submarginal cells, and the base of the 1st basal and of the combined 2nd basal and 2nd posterior cells are also bare. In the costal and subcostal cells, the microtrichia are extremely minute, often barely visible even with a high magnification. The venation is on the whole stable. The subcosta is almost invariably complete, ending in the costa. This is the case in both wings of 106 specimens examined, of both sexes from a variety of hosts and from many localities the world over. The only exception found was a ♂ from Havana, Cuba, in which the subcosta is complete in the right wing, while in the left wing it ends distinctly in the membrane some distance from the costa.

The size and shape of the metasternal spurs are also somewhat variable in *P. canariensis* (Figs. 78*A–C*). They do not differ much from those of *P. brunnea;* but in *P. rufipes* they appear to be relatively shorter, wider and blunter.

There are some interesting secondary sexual characters, in addition to those of the terminalia. The anterior median sclerite, differentiated in both sexes in the dorsal striolate area of the abdomen, varies much in shape and somewhat in size. In most flies I have seen it is a single, small, transversely elliptical plate, only slightly or not shortened in the middle (Figs. 78*F–G*), Occasionally it is emarginate medially, anteriorly, posteriorly or at both margins (Fig. 79*G*), sometimes almost divided into two narrowly connected halves. In a few flies the median connection is severed, leaving a pair of much smaller plates (Fig. 79*H*). The ♂ has, in addition to this anterior, single or duplicate sclerite, a pair of small posterior plates, lacking in the ♀, placed farther back, nearer the preäpical tergite (Fig. 78*F*) ; they also vary in size and in some cases are poorly defined. These median anterior and posterior sclerites bear several setae, somewhat finer and closer together than those of the surrounding striolate area.

The short, stout, black setae on the under (or plantar) surface of the basitarsus of the mid legs, described by Ferris (1925*a*, p. 417, fig. 3*b*) for a ♂ from the Philippines, are a sexual character present in the ♂ and absent in the ♀ of both *P. canariensis* and *P. rufipes.* According to Schuurmans Stekhoven, Silva and San Ramon (1954, pp. 393–394) there are also some very slight sexual differences in the apical setae of the tarsal segments and tibiae. On the fore legs, the 2nd and 3rd tarsal segments have 1 seta in the ♀, none in the ♂; on the mid legs, the 1st tarsal segment has 2 setae in the ♀, 5 (in groups of 2 and 3) in the ♂. The

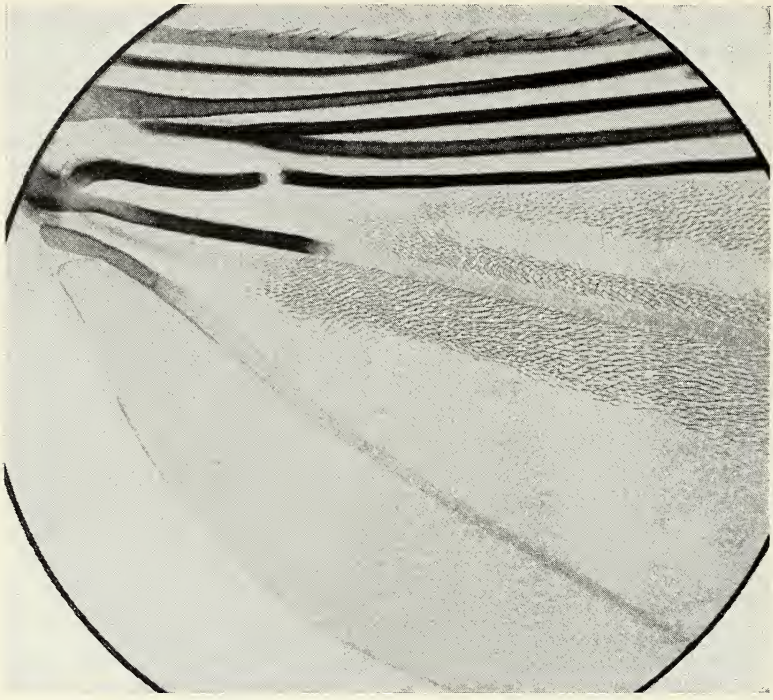

Fig. 80. *Pseudolynchia canariensis* (Macquart), basal area of wing, ♀, Jacksonville, Fla., on domestic pigeon. Photograph by Mr. K. MacArthur (1948, fig. 255).

hind tibiae end in 5 setae in both sexes, but in the ♀ they are in 2 groups (of 2 and 3) and in the ♂ they form a single group.

The unusual variation of many structural characters in *P. canariensis* may have been induced indirectly by the domestication of the host on which most specimens are collected. As is well known, the rock pigeon itself is tremendously variable under domestication.

Original description of *O. canariensis* (French text translated): "Picea. Facie, palpis pedibusque flavicantibus. Length 2¼ lines [French lines = about 5.1 mm.]. Setae of the proboscis curved, yellow, twice the length of the palpi. Palpi brownish-yellow, with black apex. Antennae with black, thick, curved setae. Face and anterior portion of frons yellowish; posterior portion brown. Thorax pitch-black. Abdomen dark. Legs dirty greenish-yellow; hind tarsi brownish. Wings yellowish-gray." The type, labelled in Macquart's handwriting, is a ♂ at the Paris Museum, where I studied it in 1951. It agrees in every respect with Bigot's *Olfersia maura*, the common fly of domestic pigeons.

Original description of *O. testacea* (French text translated): "Testacea. Pedibus ferrugineis. Alis pallidis. Length 2 lines [French lines = 4.5 mm.]. Brownish-testaceous. Palpi ferruginous. Face fulvous. Frons brown. Humeri

ferruginous, more prominent and more pointed than in the other species. Abdomen brown. Legs rather pale ferruginous. Wings rather transparent.'' The description is worthless and the figure of the wing erroneous. Fortunately the two types, labelled by Macquart, are at the Paris Museum, where I saw them in 1951. Although in such poor condition that the sex could not be determined, they are definitely recognizable as *Pseudolynchia canariensis*. Macquart's figure shows a closed 2nd basal cell, but this is not present in the types. Macquart's citation ''*Nob. S. à B.,*'' obviously refers to his earlier ''*Suites à Buffon*'' (1835); but *O. testacea* is not mentioned in that work.

Original description of *O. maura* (French text translated): ''Long. 5½ mm. Antennis castaneis, flavido setosis; epistomate et vertice testaceis, fronte fusca, utrinque nitida; thorace fusco nigro, vix nitente, humeris scutelloque sordide fulvis; abdomine obscure infuscato, segmento 2° apice fulvo marginato; pedibus testaceis, femoribus superne parum infuscatis, nigro parce setosis, posticis, externe, linea tenue, fuscana, notatis; alis fere hyalinis, venis, costali, longitudinalibus 1–4^{is}, omnino, 5^{a}, usque ad transversam 1^{am} nigram, nigro tinctis. Antennae brown, with yellowish setae; epistome [frons] and vertex [postvertex] broadly shiny yellowish; frons [face] dull brown, with shiny sides [inner orbits]; thorax a rather shiny brown, humeri yellowish, sides and scutellum pale russet; scutellum with 2 lateral setae; sternum russet; abdomen brown, 2nd segment with a narrow yellow margin; legs testaceous, with some black setae on femora, which are slightly brownish above; hind femora with a very fine, outer brown line; hind tarsi brownish beneath; wings very pale yellowish; costa, 1st, 2nd, 3rd and 4th longitudinals wholly, the 5th as far as the 1st cross-vein, the outer vein, and the 6th at base, blackish; 1st cross-vein of the same color, the 2nd very pale; two basal cells very unequal; 2nd longitudinal vein reaching costa rather far from 1st, namely opposite outer cross-vein.'' The two types are now in the J.E. Collin Collection. Through an oversight I failed to see them in 1951, when I examined the other Bigot types; but Mr. Collin kindly informs me that they are both ♀ and that the wings are 7 mm. long in one and 7.5 mm. in the other. They were seen by Speiser (1902), who stated that *maura* was very close to his *inornata,* but differed in ''the darker color of the vertex [postvertex] and the head being more sparsely setose,'' while the thorax was equally setose in both. These differences are, in my opinion, too slight to be reliable as specific characters. Moreover, I consider *maura* as identical with *canariensis* Macquart.

Original description of *O. lividicolor* (French text translated): ''Long. 5 mm. Antennis fuscis; fronte fuscana; oculis castaneis; epistomate sordide flavido; thorace piceo, parum nitente, humeris et scutello obscure fulvis; abdomine, sordido, fulvo opaco; pedibus pallide fulvidis; alis parum infuscatis, venis, costali, longitudinalibus 1–4^{is}, omnino, 4^{a}, usque ad transversam 1^{am} fuscam, infuscatis, transversa 2^{a} pallidissima. Antennae brownish, with brown setae; eyes chestnut; epistome [frons] a rather shiny dark yellowish, as are also vertex [postvertex] and inner margin of orbits; thorax pitch-colored, not very shiny; sides and scutellum indistinctly russet; scutellum with two lateral black macrochaetae; abdomen dark brownish-fulvous; legs dirty-yellowish with some brownish setae; wings very pale yellowish; costa, 1st to 4th longitudinal veins wholly, 5th as far as 1st cross-vein, 6th basally, and 1st (outer) cross-vein, brown; 2nd (inner) cross-vein very pale. First longitudinal vein (of Rondani) reaching costa far from 2nd, which stops a short distance before the level of 1st cross-vein; two basal cells very unequal.'' The type is a ♀ now in the J.E. Collin Collection, where I studied it in 1951. It agrees in every respect with the common pigeon-fly, *P. canariensis.* It should be stressed that, contrary to what might be gathered from Bigot's description, there is only one cross-vein in the wing, so that the statement about the two basal cells being unequal is meaningless. Speiser (1902) also examined this type and recognized its similarity to the other ''species'' of his *Lynchia* [=*Pseudolynchia*], but thought that it might be separated by ''the brownish instead of milky color of the

wings,'' a character scarcely of specific value in this genus. He later (1908) suggested, however, that it might be identical with *maura* (= *canariensis*).

Original description of *O. capensis* (French text translated): '' ♂ Long. 5 mm. Cinereo livido obscuro; labro testaceo; palpis pallide fuscis; fronte lata, quadrata, obscure cinerea; alis pallide cinereis, venis externis parum infuscatis, transversali fusca, ad apicem primae longitudinalis haud extra nec infra locata; oculis nigris. Of a grayish, indistinctly livid tinge; frons [face] square, dark gray, without lines or grooves; labrum [frons] testaceous; palpi long, brownish; abdomen slightly tinged with brown; wings much lengthened, pale gray; outer veins brown; the cross-vein darker, placed exactly opposite tip of 1st longitudinal vein; eyes blackish; antennae very small, brownish.'' The J.E. Collin Collection contains 3 specimens labelled *O. capensis* and one of these is the ♂ type, since Bigot definitely states that his description was based on one specimen. All 3 specimens are labelled ''Cap. Bon. Spei'' and are *Pseudolynchia canariensis*, according to my study of them in 1951. They were also seen by Speiser (1902).

Original description of *O. exornata* (translated from the German): ''Length of dry specimen, 5 mm.; of wing, 6 mm. Head yellowish-brown; antennae with black setae; on the ledges at the inner eye margin [inner orbits] with fine, yellow setulae, which are arranged on each side in two lines, the outer, thinner line being reflected over eye margin and the inner line over vertex [mediovertex]. Thorax black, with a fine, shiny white median line [median notal suture], which does not continue onto scutellum; limit between prescutum and scutum [transverse mesonotal suture] also shiny white, somewhat wider than median line, to which it is perpendicular, with only a slight posteriorly directed curve in the middle. Humeral callosities fairly pointed, yellowish-brown, as are also episterna of mesothorax. Hind margin of mesothorax curved, arched toward surface of thorax (as usual in Hippoboscidae), densely covered with long, fine, yellow setae, which spread like a fan over entire mesonotum and reach scutellum. Scutellum short, as it were truncate, 4 times as wide as long, brown, with very few short setulae. The abdomen cannot be described in detail because of the state of preservation; first segment brown, others blackish; several longer, black setae before apical notch. Legs without peculiarities, brown; base of femora paler; hind legs more blackish-brown. Wings slightly clouded with gray; venation exactly as in *Olfersia ardeae* Meq. [= *Lynchia albipennis* Say].'' In 1902, Speiser placed his *exornata* more correctly with *maura* in *Lynchia*, the name he used for what is now called *Pseudolynchia*. I studied the type at the Genoa Museum in 1951 and recognized that it is a ♀ of the pigeon-fly. I was unable to find a reliable character separating it from *P. canariensis*.

Original description of *L. simillima* (translated from the German): ''Length, 4 mm.; from margin of mouth to margin of scutellum, 3 mm. Differs from *L. exornata* Speiser and related species in yellowish-brown color of thorax; very similar to *L. capensis* Big., from which it differs in the following characters of the vertical triangle [postvertex]: anterior emargination of this triangle not filled in with white and only hind margin with a whitish-yellow border. Head and thorax umber-brown; head with bone-yellow hind margin; thorax with somewhat paler humeral angles; scutellum and longitudinal suture [median notal suture] also paler. Clypeus [frons] short, scarcely $\frac{1}{3}$ of length of remainder of head, its apical edges only slightly produced, itself only a trifle paler than rest of head. Maxillary palpi only very slightly curved. Wings with a very weak whitish cloud; venation without pecularities. Legs and abdomen without special features.'' This description was based on a specimen originally referred rather doubtfully to *Olfersia spinifera* by van der Wulp (1880), with the following notes (translated from the Dutch): ''What Wiedemann and Schiner say of the so-called ''thorn'' on the thorax anteriorly [humeral callosities], applies entirely to my specimen. However, I do not see the two deep transverse grooves on the frons [face] which Schiner mentions;

the frons [face] is on the whole somewhat depressed medially [mediovertex] and somewhat raised and also more shiny on the sides [inner orbits]. Furthermore, Schiner calls the face produced as a cone; I do not quite understand what he means by this, unless he refers to the sides of the face below the eyes, which are somewhat triangular in profile. Moreover, in my specimen the head and thorax are covered with a thick, yellowish, flattened pilosity; the sides of the thorax, the hind margin of the scutellum and the tip of the abdomen bear black setae. The femora and tibiae of the brownish-yellow legs are translucent. What makes me suspect that this may be a different species from the one mentioned by Schiner is especially that he calls the anal cell (the lower basal cell) of the wings short but distinct; for in my specimen, which shows the venation distinctly, the anal cell is actually lacking, because the cross-vein which should close it on the outer side is missing.'' It should be noted that van der Wulp misunderstood Schiner's term ''untere Basalzelle,'' which refers to the closed 2nd basal cell (present in *Olfersia* and *Lynchia,* absent in *Pseudolynchia*), not to the anal cell (absent in all 3 genera). In 1951 I studied this specimen at Amsterdam in the de Meijere Collection now in the care of the Netherlands Entomological Society. It is labelled ''*simillima*'' in Speiser's handwriting, although not marked as a type. I was unable to find that it differed in any respect from the usual *Pseudolynchia canariensis,* a common parasite of domestic pigeons in Java (specimens seen from Batavia [Djakarta], Sukabumi, and Bandung in Preanger).

Original description of *O. garzettae:* ''Nigricante picea, abdominis lateribus pallidiusculis; fronte, proboscide, antennis, maculis humeralibus, et linea basale scutelli sub-testaceis. Alae fuscescentes, venula transversa interiore deficiente: longitudinale tertia costali conjuncta paulo magis longe a quarta quam a secunda. Pedes omnes et toti fusco-obscuri, unicolores.'' No measurements are given. Rondani's genus *Olfersia* comprised Italian species without closed anal cell [Rondani's areola axillaris]. He divided them into those with a closed 2nd basal cell (''Venula transversa interior quamvis abbreviata semper distincta''), now placed in *Lynchia,* and those without such a cell (''Venula transversa interior omnino nulla''), now placed in *Pseudolynchia* and *Microlynchia.* His *garzettae* and *falcinelli* are both included in the second group and are separated on the basis of the color of the wings (''fuscae'' for *garzettae;* ''sub-limpidae'' for *falcinelli*) and of the legs (''toti obscure fuscescentes'' for *garzettae;* ''sordide lutescentes'' for *falcinelli*). According to Dr. B. Lanza (*in litt.,* 1953), the types of both *garzettae* and *falcinelli* are in Rondani's Collection, now at the Florence Museum. They do not appear to have been studied by any later author. Speiser (1902) included *garzettae* in *Lynchia,* the name he used for *Pseudolynchia,* and he later referred to it a specimen from Bavaria; but he does not state how he arrived at this identification. However, a ♂ from Genoa, taken on *Circaëtus gallicus,* which I saw at the Genoa Museum, had been named ''*Lynchia garzettae* Rondani'' by Speiser. This specimen is not separable from *Pseudolynchia canariensis* (Macquart). As Rondani's description agrees well with *P. canariensis* and as none of his other descriptions can be definitely referred to the pigeon-fly, which is common in Italy, it is practically certain that *garzettae* was based on this insect. The specific name is meaningless, since Rondani states explicitly that the host of his fly was unknown. Bau (1929) also determined 3 flies in the v. Röder Collection, from Greece, as *Lynchia garzettae,* but gave no reasons for doing so.

Pseudolynchia brunnea (Latreille)
Figs. 81*A–F* and 82

Ornithomyia brunnea Latreille, 1812, in Olivier, Encyclop. Méthod., Insectes, 8, pt. 2, p. 544 (no sex; no host. ''Carolina'' [probably South Carolina and possibly near Charleston; see below]. Type probably lost). Osten Sacken, 1858, Cat. Dipt. North America, p. 86.

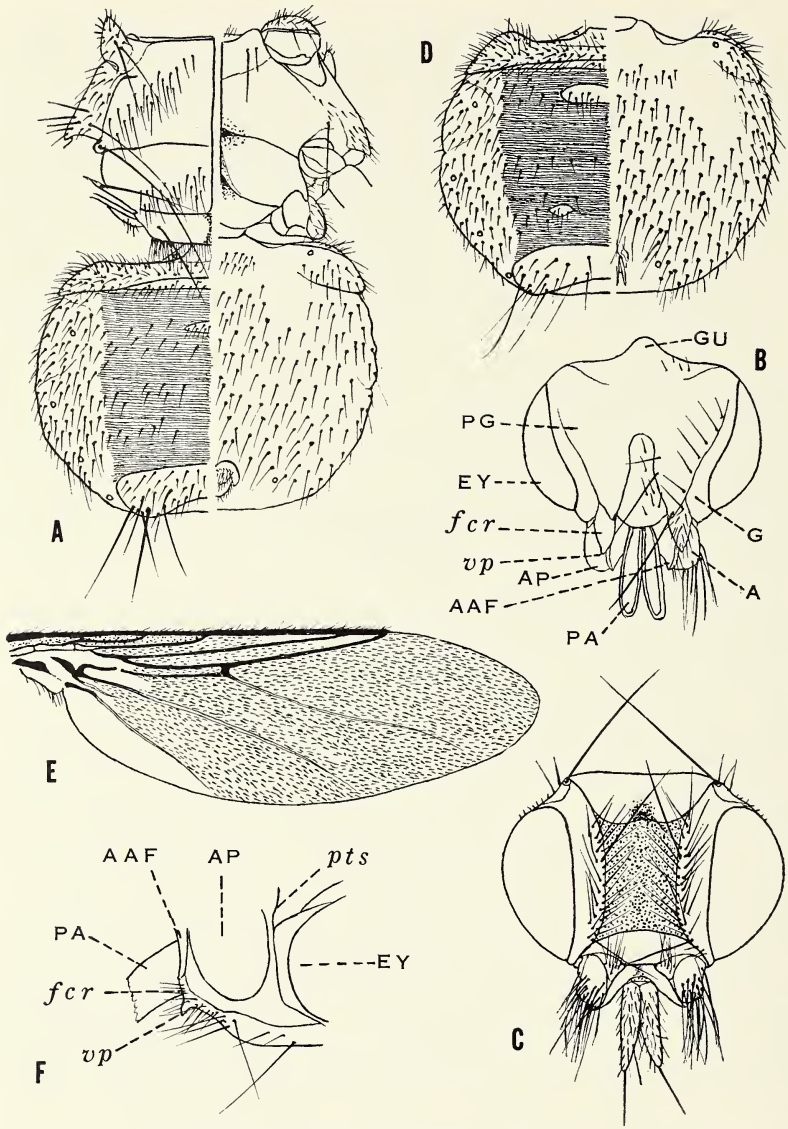

Fig. 81. *Pseudolynchia brunnea* (Latreille). **A–C,** ♀, Royal Palm State Park, Fla., on *Caprimulgus carolinensis:* **A,** thorax and abdomen dorsally and ventrally; **B,** head from behind: *A,* antenna; *AAF,* apical arm of frons; *AP,* antennal pit; *EY,* eye; *fcr,* facial ridge; *G,* gena; *GU,* gula; *PA,* palpus; *PG,* postgena; *vp,* vibrissal protuberance; **C,** head in front view; **D,** abdomen dorsally and ventrally, ♂, Eau Gallie, Fla., on *Chordeiles minor chapmani;*

Olfersia brunnea Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 213. Howard, 1883, South Carolina, Resources and Population, p. 275. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 655. Washburn, 1905, Univ. Minnesota, Agric. Expt. Sta., Bull. **93**, p. 163 (Minnesota: on *Chordeiles m. minor*).

Lynchia (?) *brunnea* Speiser, 1904, Ann. Mus. Nat. Hungarici, **2**, p. 388; 1907, Ent. News, **18**, p. 104. Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Pseudolynchia brunnea J. Bequaert, 1926, Psyche, **32**, (for 1925), pp. 271 and 276. Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 49 (Mexico. Argentina). J. Bequaert, 1935, Rev. Zool. Bot. Afric., **27**, pp. 395 and 396, fig. 1*C*. Peters, 1936, Bird-Banding, **7**, p. 18 (Ohio: on *Chordeiles m. minor*). Brimley, 1938, Insects North Carolina, p. 390 (North Carolina: Raleigh). J. Bequaert, 1938, Ent. News, **49**, p. 42; 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, p. 324; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416. Essig, 1942, College Entomology, p. 815. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, pp. 426 and 427, fig. 254 (Minnesota: without precise locality, on *Chordeiles m. minor*). Swain, 1948, The Insect Guide, p. 214, fig. 174*b*. Herms, 1950, Medical Entomology, 4th Ed., p. 414.

Lynchia maura Knab, 1916, Insecutor Inscitiae Menstruus, **4**, p. 3 (in part: specimen from Ames, Iowa, only). Not of Bigot, 1885.

Pseudolynchia sp. Travassos and Teixeira de Freitas, 1941, Mem. Inst. Osw. Cruz, **35**, (for 1940), pt. 3, p. 542 (Brazil: Salobra, State Matto Grosso, on *Nyctidromus albicollis derbyanus*).

Distribution and Specimens Examined. Dominion of Canada. Ontario: Low Bush, Lake Abitibi, on *Chordeiles m. minor*, July 22 (N.K. Bigelow).

United States. Arkansas: Hot Springs, Yavapai Co., 8 ♀ ♂ on *Caprimulgus v. vociferus*, May 5 (R. Dahm). — Florida: Princeton, Dade Co., 11 specimens on a dying *Caprimulgus v. vociferus*, Feb. 25 (W. Byrd); Royal Palm State Park, Dade Co., on *Caprimulgus carolinensis*, Oct. 22 (C.A. Mosier); Eau Gallie, Brevard Co., on *Chordeiles minor chapmani*, May 5 (W.W. Worthington); St. Vincent I., Franklin Co., on *Caprimulgus carolinensis*, Nov. 1 (W.M. McAtee); Munroe Co., on *Caprimulgus carolinensis* (D.J. Nicholson); St. Augustine, St. Johns Co., on *Caprimulgus carolinensis* (C.W. Johnson). — Georgia: [Neel Gap or Frogtown Gap, Union Co. — P.W. Fattig, *in litt.;* not seen]. — Iowa (recorded by Knab, 1916, by error as *Lynchia maura*): Ames, Story Co. (Knab's specimen). — Kansas: Kansas City, Wyandotte Co., on *Chordeiles m. minor* (S.R. McLane). — Maryland: Leeland, Prince Georges Co., Aug. 26, on *Caprimulgus v. vociferus* (A.B. Howell). — Massachusetts: Wareham, Plymouth Co., on *Caprimulgus v. vociferus* (O. Bangs); Sherborn, Middlesex Co., on *Caprimulgus v. vociferus*

E, wing, ♀, Santiago de Cuba; **F**, lower anterior edge of head in profile, ♂, Orient, N.Y., on *Chordeiles m. minor: AAF*, apical arm of frons; *AP*, antennal pit; *EY*, eye; *fcr*, facial ridge; *pts*, ptilinal suture; *vp*, vibrissal protuberance; *PA*, palp.

(C.W. Johnson). — Michigan: Long Point, Monroe Co., on *Hylocichla fuscescens salicicola,* May 9 (P. Brodkorb). — Minnesota (recorded by Washburn, 1905; MacArthur, 1948): without precise locality, on *Chordeiles m. minor,* June 2. — New Mexico: Alamogordo, Otero Co., May 7. — New York: Orient, Long Island, on *Chordeiles m. minor,* May 30 (Roy Latham). — North Carolina (recorded by Brimley, 1938): Raleigh, Wake Co., (H.H. Brimley). — Ohio (recorded by Peters, 1936): Adams Co., on *Caprimulgus carolinensis* (M. Trautman). — South Carolina (recorded by Latreille, 1812). — Tennessee: Nashville, Davidson Co. (Mrs. A.R. Laskey). — Texas: 20 miles S.W. of Eagle Lake, Colorado Co., on *Caprimulgus carolinensis;* [Camp Bullis near San Antonio, Bexar Co., on *Caprimulgus carolinensis* and *Phalaenoptilus n. nuttalli.* — J.M. Brennan, *in litt.;* not seen]. — Virginia: Hot Springs, Bath Co., on *Caprimulgus v. vociferus* (W. Robinson).

Mexico (recorded by Falcoz, 1930): without more definite locality (A. Sallé); Arriaga, State Chiapas, May 24 (P. Brodkorb).

Panama: Barro Colorado, C.Z., on *Chordeiles a. acutipennis* (R.C. Shannon).

Antilles. Cuba: Santiago de Cuba, Prov. Oriente.

Brazil (recorded by Travassos and Teixeira de Freitas, 1941): Matto Grosso, on nighthawk (R.C. Shannon); Ypiranga, State São Paulo, on *Chordeiles m. minor* (J. Lima); Salobra, State Matto Grosso, on *Nyctidromus albicollis derbyanus* (Inst.Osw.Cruz. — Recorded by Travassos and Teixeira de Freitas, 1941, as *Pseudolynchia* sp.); Rio de Janeiro, D.F., on *Hydropsalis b. brasiliana* (A. Diniz); Botucatú, State São Paulo, on *Nyctidromus albicollis derbyanus* (Werner).

Argentina (recorded by Falcoz, 1930): Territorio Río Negro (L. Guttieres); Bariloche, Territorio Río Negro, on nighthawk, Nov. (R.C. and E. Shannon); Icano, Santiago del Estero (E.R. Wagner); Tucumán, on juvenile *Setopagis p. parvula,* Apr. 5 (K.J. Hayward).

P. brunnea is restricted to America, where it is probably more common than the available records indicate. Specimens are difficult to collect because of the peculiar habits of the breeding hosts. It seems to occur over most of the temperate and tropical parts of the New World, since it is known from southern Canada (48° 35′ N.) to northern Argentina (about 28° S.).

Known Nearctic Hosts of *P. brunnea* (verified individual records in parentheses). Caprimulgiformes (15): *Caprimulgus carolinensis* (5); *C. v. vociferus* (5); *Chordeiles m. minor* (4); *C. minor chapmani* (1); *Phalaenoptilus n. nuttallii.* Passeriformes: *Hylocichla fuscescens salicicola* (1).

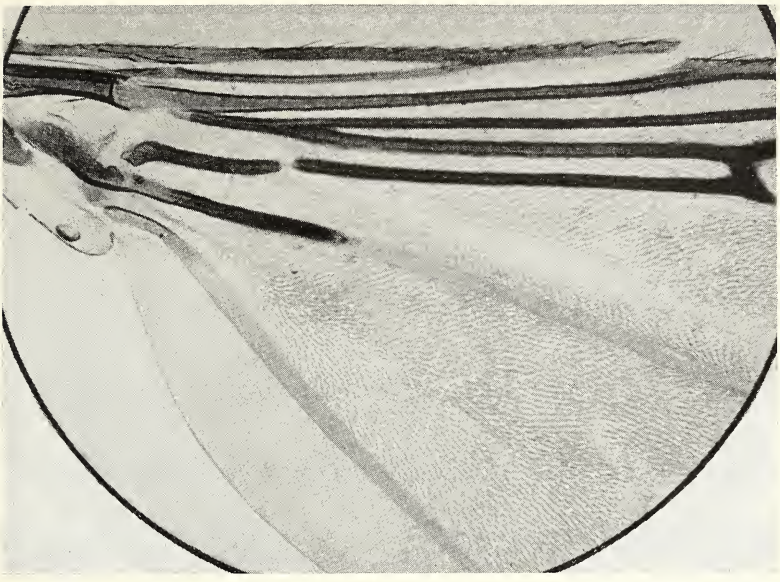

Fig. 82. *Pseudolynchia brunnea* (Latreille), basal area of wing, Minnesota, on *Chordeiles m. minor*. Photograph by Mr. K. MacArthur (1948, fig. 254).

Known Neotropical Hosts of *P. brunnea*. Caprimulgiformes (6 and 2 unnamed nighthawks) : *Chordeiles a. acutipennis* (1) ; *C. m. minor* (1) ; *Hydropsalis b. brasiliana* (1) ; *Nyctidromus albicollis derbyanus* (2) ; *Setopagis p. parvula* (1).

Bionomics. The records leave little doubt that *P. brunnea* is a strictly specific parasite of Caprimulgidae. The one record from a willow thrush is clearly accidental and I suspect due to an error or to *post mortem* contamination. The puparium and other details of the life history are unknown. To the one case of infestation with mites mentioned in Part I (p. 159) may be added a ♂ from Orient, N. Y., on *Chordeiles m. minor*, carrying several mite clusters on the under side of the veins in both wings.

Affinities. The characters given in the key will separate *P. brunnea* from both *P. canariensis* and the Old World *P. rufipes*. The basal portion of the interantennal area of the frons of *brunnea* is decidedly narrower than its shortest distance from an eye (as in *rufipes*) ; also relatively longer than in *canariensis* and often with a shallow longitudinal groove. The postvertex is short, semi-elliptical, similar to that of *canariensis*, with a deep, sometimes pit-like anterior emargination. The antennae appear to be relatively broader than in *canariensis*. The palpi are distinctly shorter than

the mediovertex. The humeral callosities are slender, longer than wide. Seen from above, the preälar tip of the anepisternum is more pointed than in *canariensis,* though not projecting outwardly. The metasternal tooth is long and narrow, somewhat more slender than in *canariensis.* The striolate median area of the abdomen is almost bare, with an anterior differentiated median sclerite in both sexes and, in the ♂, an additional posterior pair of small sclerites (Figs. 81*A* and *D*). The thoracic dorsum and the abdomen are much less setose than in *canariensis;* the orbital bristles also are fewer and more restricted to the inner half of the orbit, though in more than one irregular row.

In the wing, the distribution of the microtrichia is similar to that of *canariensis,* except for the characteristic greater extent in the combined anal, 3rd posterior and axillary cells, which are bare only in the extreme base; in some flies the cell has irregular bare spots toward the axillary vein. The bare streak in the combined 2nd basal and 2nd posterior cells is usually narrow and short, sometimes barely indicated or even lacking. There is no bare streak along the 2nd longitudinal vein. The subcosta is complete in all specimens seen thus far.

Original description of *O. brunnea* (French text translated): "*O.* ocellis nullis, corpore brunneo, ore, thoracis angulis anticis pedibusque pallidis; alis subovalibus. It is 3 [French] lines [= about 6.7 mm.] long from the head to the tip of the wings and a little less if only the body is measured. It is dark-brown, with the mouth, occiput [postvertex], anterior angles of the thorax, sternum and legs pale yellowish. The eyes are dark. The yellow area of the occiput [postvertex] forms a notched spot. The dorsum of the thorax bears yellowish hairs. The scutellum is short, broad, truncate, transverse. The wings are large, nearly ovate, with yellowish veins; those near the costa are darker." The type, collected by L. A. G. Bosc d'Antic in one of the Carolinas, is now lost, so far as could be traced. It is not now at the Paris Museum. From 1798 to 1800 Bosc resided in the United States, where according to Cuvier (1829, Mém. Mus. Hist. Nat., Paris, **18,** p. 82) he spent most of his time studying natural history at the Botanical Garden which André and François-André Michaux had established about 10 miles from Charleston (see R.H. True, 1937, Proc. Amer. Phil. Soc., **78,** No. 2, p. 315). It is therefore fairly certain that the type of *brunnea* came from South Carolina, most probably from the vicinity of Charleston. Latreille's description was certainly based on a species of *Pseudolynchia,* as the "short, broad, truncate, transverse scutellum" can only refer to this genus. Since there is no evidence that the pigeon-fly had reached the United States by 1800, *P. brunnea* must have been the specific *Pseudolynchia* of American Caprimulgidae, the only native New World species of the genus. Moreover, if the length given by Latreille was measured with the wings folded over the abdomen, it fits *P. brunnea* better than *P. canariensis* as found on domestic pigeons in America. Osten Sacken (1878) first referred *brunnea* to *Olfersia,* a name used at that time for all hippoboscids with an open anal cell; but it is not known whether he saw a specimen. Speiser (1904) suggested that it might be a *Lynchia* (the name he used for the species now placed in *Pseudolynchia*), but he did not see it.

(*To be concluded and indexed in vol. XXXVI*)

ENTOMOLOGICA AMERICANA

A JOURNAL OF ENTOMOLOGY.

Volume XXXVI (New Series)
for 1956

PUBLISHED BY THE
BROOKLYN ENTOMOLOGICAL SOCIETY
1957

ENTOMOLOGICA AMERICANA

Vol. XXXVI (N. S.), for 1956

CONTENTS

VOL. XXXVI (New Series)

ENTOMOLOGICA AMERICANA

A JOURNAL OF ENTOMOLOGY.

PUBLISHED BY THE

BROOKLYN ENTOMOLOGICAL SOCIETY

Published for the Society by the
Business Press Inc.
N. Queen St. and McGovern Ave., Lancaster, Pa.
Subscription, $5.00 per year
Date of issue, January 28, 1957

ENTOMOLOGICA AMERICANA

VOLUME XXXVI

THE HIPPOBOSCIDAE OR LOUSE-FLIES (DIPTERA) OF MAMMALS AND BIRDS

PART II. TAXONOMY, EVOLUTION AND REVISION OF AMERICAN GENERA AND SPECIES

BY JOSEPH C. BEQUAERT

ALEXANDER AGASSIZ PROFESSOR OF ZOOLOGY
MUSEUM OF COMPARATIVE ZOOLOGY AT HARVARD COLLEGE,
CAMBRIDGE, MASSACHUSETTS

(*Concluded from volume XXXV*)

CONTENTS

Olfersia Wiedemann, 1830

Feronia Leach, 1817 (September), Gen. Spec. Eproboscideous Ins., pp. 3, 4, 6, and 11 [1818, Mem. Werner. Nat. Hist. Soc. Edinburgh, **2**, pt. 2, pp. 549, 550, 552, and 557] (for three species: *F. spinifera* Leach, 1817; *F. americana* Leach, 1817; and *F. macleayi* Leach, 1817); 1817 (November), in Brewster's Edinburgh Encyclopaedia, **12**, pt. 1, p. 162 (with brief diagnosis: "ocelli none." Monotypic for *Feronia spinifera* Leach). Coquillett (1910, Proc. U. S. Nat. Mus., **37**, p. 545) also designated *Feronia spinifera* as type.[59] Not *Feronia* Latreille, 1817 (presumably before Leach's two publications of 1817).

Ceronia "Leach" E. Blanchard, 1840, Hist. Nat. Insectes, **3**, p. 631 (misspelling of *Feronia;* in synonymy of *Olfersia*).

Olfersia Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 605 (substitute name for *Feronia* Leach, 1817, including Leach's three species). Type by designation of Speiser, 1899, Wien. Entom. Zeitg., **18**, p. 202: *Feronia spinifera* Leach, 1817.

Pseudolfersia Coquillett, 1899, Canad. Entom., **31**, p. 336 (monotypic for *Pseudolfersia maculata* Coquillett, 1899 = *Lynchia fumipennis* Sahlberg, 1886).

Psuedolfersia Washburn, 1905, 10th Ann. Rept. State Entom. Minnesota, p. 159 (misspelling of *Pseudolfersia;* in the combination *Psuedolfersia maculata* Coquillett).

Pseudoolfersia Vogelsang, 1936, Rev. de la Policlinica, Caracas, **6**, No. 31, p. 2. 123 (in the combination *Pseudoolfersia vulturis* v. d. Wulp = *Olfersia bisulcata* Macquart).

Generic Characters. Permanently fully-winged flies, parasitic of birds. Medium-sized and robust; head and thorax strongly flattened. Head very flat, large, slightly wider than high, transversely elliptical, inserted in the broadly concave and trisinuate anterior margin of prescutum. Ocelli absent. Eyes large, mostly dorsal, bordered along the outer orbits (ventrally) by a narrow, blunt rim, of many superficially divided, minute ommatidia (almost obliterated in *O. sordida*). Upper orbit distinct, often very long. Postvertex and frons of about equal length, meeting or nearly meeting at ptilinal suture; mediovertex either absent or reduced to small triangles at lower sides of postvertex. Occipital margin convex, often partly overlapping anterior margin of prescutum, sometimes produced behind and separated by broad notches from upper orbits. Frons (Figs. 84*A–D*) large, of a single flattened sclerite in which lunula is in most species completely fused with interantennal area (or frontal carina); position of lunula marked only by a median pit or (in *O. bisulcata* and *O. fumipennis*) by short traces of sutures at the antennae; frontal carina very wide, its anterior $\frac{1}{2}$ to $\frac{2}{3}$ divided by a narrow median,

[59] Coquillett states that Speiser designated the type of *Feronia* in 1899, but this is not strictly correct. Speiser gave "*Feronia spinifera*" as the type of *Olfersia* and did not cite *Feronia* as a synonym of *Olfersia.*

longitudinal slit into flattened, partly rugulose areas corresponding to the apical arms of other Ornithomyiinae; the diverging apices very short and broadly triangular. Antennal pits far apart, each completely surrounded by a rim. Postvertex without pit, either forming one smooth, flat sclerite (*O. sordida*) or partly divided by a superficial, transverse, curved depression into an upper smooth and a lower dull area (the latter more or less alutaceous, owing to a microscopic maze or mosaic of very fine impressed lines). Antennae medium-sized, mostly or entirely contained within the antennal pits; 1st segment large, flat, distinct from the 2nd, completely or partly separated by a basal suture from the sides of the lunula; appendage of 2nd segment short and narrow, not or barely reaching the diverging apices of frons; arista of 3rd segment with a thick basal and a finely divided apical portion. Palpi well developed. Thorax (Fig. 89*A*) strongly depressed. Protergum very short, hidden by the occipital margin. Humeral callosities prominent, conical, straight; posthumeral suture incomplete, deep and transverse posteriorly, not reaching anterior margin of prescutum. Prothoracic spiracle small, narrow, dorso-lateral in the notch between humeral callosity and anepisternum. Antero-median area of prescutum flat, its post-occipital margin trisinuate, being bluntly produced on either side of the median inward curve; transverse mesonotal suture near hind third of mesonotum, curved backward, and nearly complete, though often weak medially; postalar calli scarcely set off from disk of mesonotum; median notal suture an extremely fine line, sometimes indistinct; notopleuron completely fused with prescutum, its position indicated only by a projecting apical lobe usually bearing one, rarely two notopleural bristles (none in *O. sordida*). Dorsal aspect of anepisternum (Fig. 87*H*) narrow, lath-shaped, rather abruptly widened posteriorly into a broad, bluntly rounded or truncate, lateral protuberance, which slants downward and curves into the pleuron. Scutellum large, transversely rectangular, with nearly straight, blunt hind margin; its disk flat or slightly convex, without transverse or longitudinal depressions. Metanotal pleurotergite (Fig. 87*G*) retort-shaped, finely hairy, the long outer portion moderately swollen, ending inwardly (at the side of the scutellum) in a short, blunt, finger-shaped process directed backward and set off by a basal constriction. Sternum: suture between prosternum and mesosternum lacking; prosternum forming two broad lobes between fore coxae, the lobes evenly rounded anteriorly and separated by a wide, shallow inward curve; other transverse and longitudinal sutures

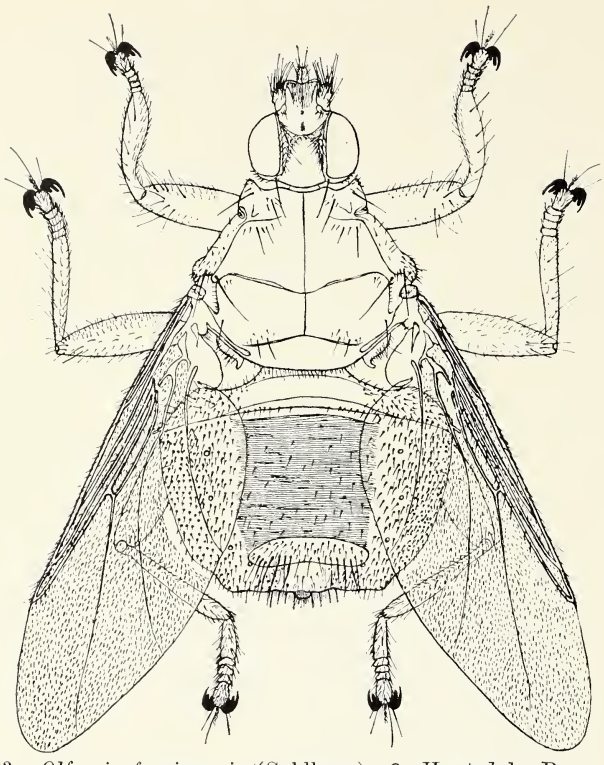

Fig. 83. *Olfersia fumipennis* (Sahlberg), ♀, Huntsdale, Pa., on *Pandion haliaetus carolinensis*. ×about 8.

either nearly complete or partly obliterated, sometimes superficial or indicated mainly at the furcal pits; no metasternal tooth over base of hind coxa; sutures of pleura mostly obliterated; anterior area of mesopleuron hollowed as a deep groove, slanting forward to receive the retracted fore femur. Metathoracic spiracle plainly visible at extreme lower edge of pleurotergite, close to and above insertion of hind coxa. Legs of the usual shape; femora moderately swollen; claws seemingly tridentate (Fig. 89*D*); tooth proper deeply bifid, with the inner branch particularly long and bluntly pointed; basal heel a flattened tooth.[60] Wing (Fig. 14*E*) func-

[60] Kieffer (1900, p. 338) grouped *Olfersia* with *Hippobosca* and *Melophagus* among the flies with so-called "split claws" (that is two-pronged, with a simple apical tooth and a basal heel only); but this is erroneous, as the claw of *Olfersia* is three-pronged, as in *Ornithomyia*.

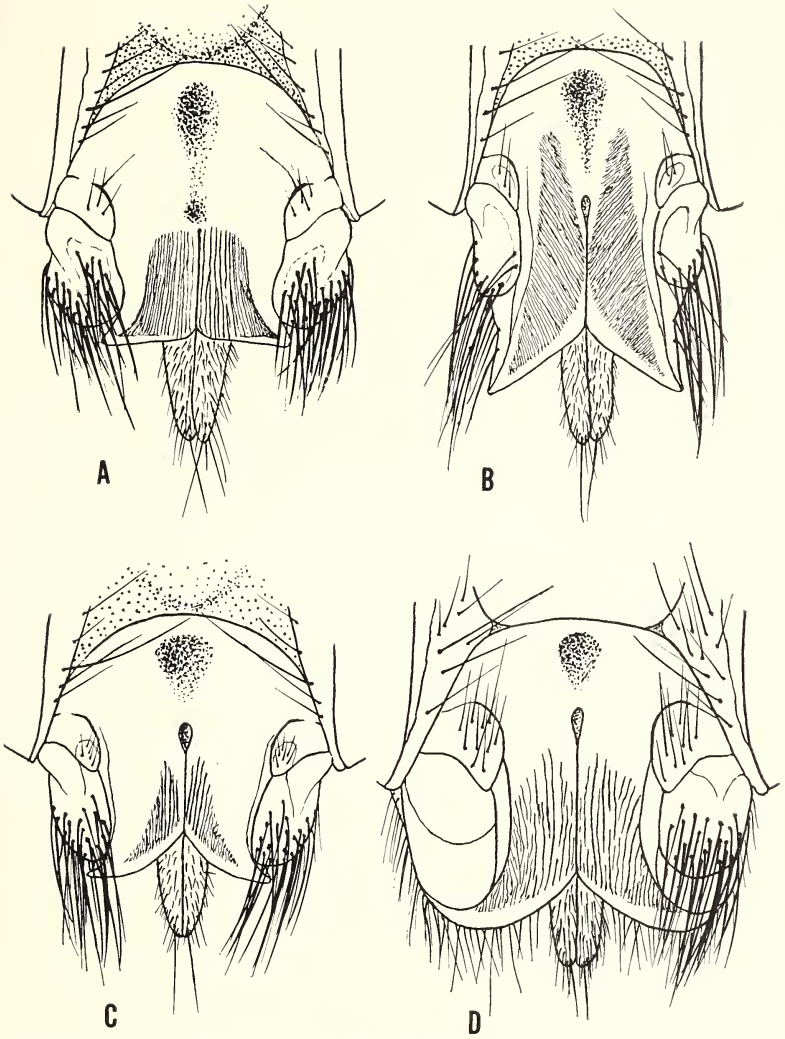

Fig. 84. Frontal area and antennae of *Olfersia;* **A**, *O. fumipennis* (Sahlberg), ♀, Huntsdale, on *Pandion haliaetus carolinensis;* **B**, *O. coriacea* van der Wulp, ♀, Gallon Jug, on *Agriocharis ocellata;* **C**, *O. aenescens* C.G. Thomson, ♀, Ascension I.; **D**, *O. sordida* Bigot, ♀, Trinidad, on *Pelecanus o. occidentalis,* with 2nd antennal segment removed on one side to show the pit.

tional throughout adult life, long and broad; venation essentially as in *Lynchia:* 6 distinct longitudinal veins beyond the subcosta, none of them confluent; subcosta reaching costa; only 2 cross-veins, the anterior and anterior basal; posterior basal cross-vein lost and true 6th longitudinal vein (*6* in Fig. 89*A*) even more reduced than in most *Lynchia;* cell between 5th longitudinal and axillary veins a combination of anal, 3rd posterior and axillary cells; a large postaxillary cell, sometimes with a longitudinal crease or rudimentary vein; membrane extensively covered with microtrichia on both upper and under surfaces, giving the wing a clouded or smoky appearance; alula very broad, not fringed; upper and lower calypteres present, but narrow. Halteres present, of normal shape. Abdomen with few differentiated sclerites; dorsally a large, transverse, basal sclerite (fused pleurotergites 1 and 2, as indicated by the position of spiracles 1 and 2), with the hind margin shallowly curved inward (in *O. sordida* triangularly excised in ♂, bilobed in ♀); as a rule, immediately behind this a single transverse, short median sclerite, sometimes partly divided medially, or with a pair of smaller, differentiated areas; a large, transverse preänal tergite, apical or ventral; sometimes traces of an additional lateral sclerite corresponding to spiracle 3; median dorsal area very finely, transversely striate (as in *Lynchia*), nearly bare; 7 pairs of abdominal spiracles, placed as in *Lynchia* (Fig. 89*C*); spiracle 2 usually free in ventral membrane, close to the ventral edge of basal pleurotergite, exceptionally (in *O. fossulata*) within pleurotergal sclerite. Rim of small, subcircular, saucer-shaped anal sclerite in ♀ usually with a pair of lobes projecting over the paragenital sclerite (Figs. 87*E* and 88*G*). Male terminalia as in *Lynchia,* without traces of gonocoxites; setigerous lobes (replacing the gonocoxites) developed into long, flap-like or finger-shaped, densely setulose processes. In a resting position the lobes cover the genital atrium, lying side by side, with the tips directed backward, and hiding the retracted 3 rods of the aedeagus (Fig. 88*F*). When the aedeagus is protruded for mating, the lobes are spread out to the right and left (Figs. 88*E* and 92). As the setigerous lobes are only slightly sclerotized, they shrivel in dry, pinned specimens and their shape cannot be trusted as characteristic for the several species. Setae of body rather sparse and short, particularly on thorax, which is mostly bare, except on humeral callosities, dorsal aspect of anepisterna, and small patches on sides of notum and near scutellum; scutellum without bristles, fringed beneath hind margin with short, soft hairs; preänal tergite with

a few long bristles; as a rule some longer bristles among the short setae on venter near anal and genital sclerites. Most species have a long or short row of stiff setulae on 1 or (rarely) 2 longitudinal veins. Head and thorax black, with few or no brownish or russet areas, often slightly metallic-greenish or bronzy; body never showing dull-green haemolymph through the integument.

Olfersia is in all essential characters one of the Ornithomyiinae, but with unusual specializations, such as the extension of the postvertex, the modified frons, the fusion of prescutum and notopleuron, the retort-shaped pleurotergal processes, and the hirsute puparium. These peculiarities have induced me to place it in a distinct tribe Olfersiini (Pt. II, p. 16).

Olfersia is chiefly tropicopolitan, extending only occasionally into subtropical areas. *O. fumipennis* is exceptional in that it spreads during the summer to the North temperate zone, as far north as its host, the osprey (*Pandion haliaetus*), breeds. The genus comprises 7 species, all found in the New World, 3 being endemic there.

Although *Olfersia* is a distinctive and compact genus of relatively few species, it uses for breeding purposes a variety of unrelated birds; but the hosts of each species belong to a definite taxonomic or ecological group. Thus *O. coriacea* is a specific parasite of game birds (Galliformes); *O. bisulcata* of Cathartidae (Falconiformes); *O. fumipennis* of Pandionidae (Falconiformes); *O. spinifera* of Fregatidae (Pelecaniformes); *O. aenescens* of Procellariiformes (Diomedeidae and Procellariidae), Pelecaniformes (Phaethontidae and Sulidae) and possibly Charadriiformes (Laridae); *O. sordida* of Pelecaniformes (Phalacrocoracidae and Pelecanidae); and *O. fossulata* of Pelecaniformes (Phalacrocoracidae, Sulidae and Pelecanidae). Occasional occurrences of these several species on other types of hosts appear to be due to accidental straying.

The puparium or full-grown larva are now known for 5 of the 7 species. In general shape these stages are similar to those of *Lynchia* and *Pseudolynchia*. They differ conspicuously, however, in being fairly uniformly covered with long, erect or slightly slanting, stiff hairs, a peculiarity not known elsewhere in Hippoboscidae. These hairs were first noticed on the puparium of *O. spinifera* by Courtiller (1853). The hairs are simply pointed in *O. bisulcata* (Fig. 93*F*); whereas their tips are anchor-shaped, provided with a pair of divergent minute barbs, in *O. spinifera*, *O. aenescens* (Fig. 88*I*), *O. fumipennis* and *O. coriacea*. The

hooklets are often missing, however, on most of the hairs, because the tips break off very easily. The meaning or use of the hirsute covering of the puparia is a moot point. A rather obvious surmise is to regard them as a means of adhering to the plumage of the host. This function is, however, most improbable in view of the fact that in all species for which observations are available, the gravid female leaves the host before voiding the full-grown larva, so that the puparia are normally found away from the birds. I suggest that after larviposition the puparia gather debris in the hairs so as to conceal them from potential parasites or predators. The hairs may also help the puparia to adhere more securely to the hiding places, particularly in the windswept rookeries of oceanic or shore birds, which are specific breeding hosts of some of the flies.

Considering the many specimens that I have examined, species of *Olfersia* appear to be on the whole less attacked by mites than most other genera of bird-flies. On the other hand, they are more often infested with the peculiar entomophagous fungi of the Order Laboulbeniales. In Part I (p. 141) I reported their occurrence on *O. bisulcata*, *O. aenescens* and *O. fumipennis*. I have since observed these fungi also on *O. sordida* and *O. coriacea*, so that they are known at present from 5 of the 7 species. According to Dr. R.K. Benjamin, who is studying this material, each of the 5 species of *Olfersia* seems to harbor its own specific *Trenomyces*. It should be noted that these fungi of hippoboscids are very minute, only a fraction of a mm. in length, so that they are easily overlooked. In addition they are dioecious, the male individuals being even smaller than the female. Both sexes may occur on the same individual fly, however. Material is most satisfactory for their study on flies originally collected and kept in alcohol.

Key to Species of *Olfersia*

The key includes only a selection of the characters which I have found most reliable for a preliminary identification. Additional distinguishing features are mentioned in the discussion of the affinities of the several species. Particular attention should be called to the shape and sculpture of the frons (fused lunula and interantennal area or frontal carina). This structure, highly distinctive for the genus, appears also to be most useful in determining the degree of intrageneric relationship of the species. A comparison of the drawings in Figs. 84, 85 and 86 will be more instructive in this connection than elaborate descriptions. *O. coriacea*

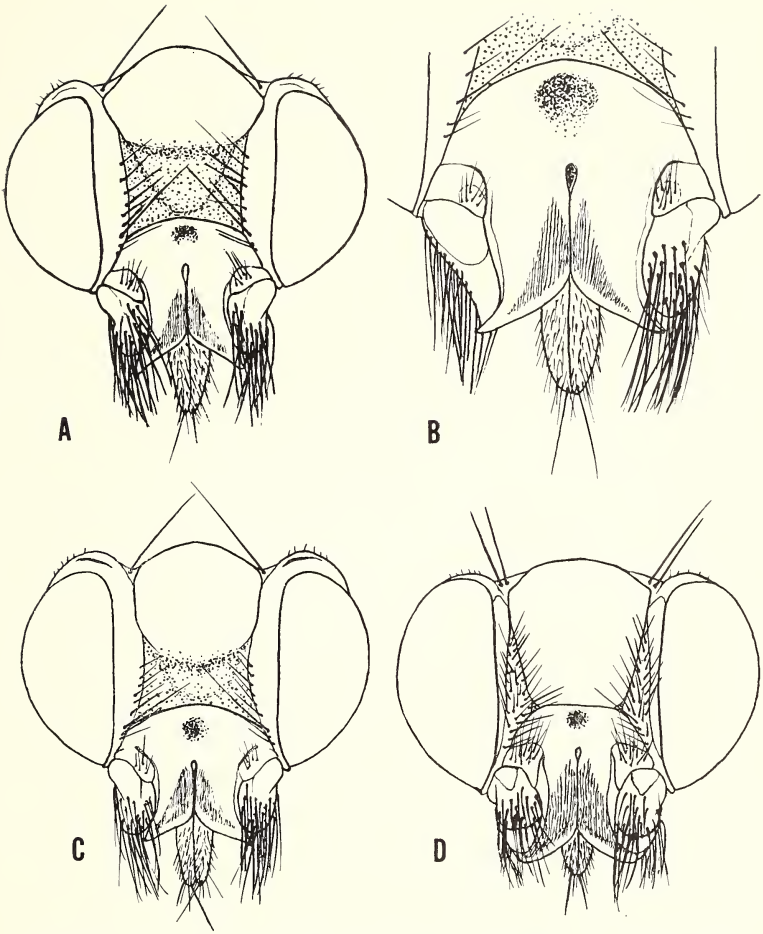

Fig. 85. **A**, head of *Olfersia spinifera* (Leach), ♂, Mayagüez, on *Fregata magnificens rothschildi;* **B**, frontal area and antenna of same, with 2nd antennal segment removed on one side to show the pit; **C**, head of *O. aenescens* C.G. Thomson, ♂, Ascension I.; **D**, head of *O. sordida* Bigot, ♀, Panama City, on *Pelecanus occidentalis californicus.*

(Fig. 84*B*) and *O. sordida* (Fig. 84*D*) are the most aberrant, each of them being also in other respects isolated within the genus. On the other hand, *O. spinifera* (Fig. 85*B*) and *O. aenescens* (Fig. 84*C*) show no appreciable differences possibly of diagnostic value, indicating how very closely related they are. *O. fumipennis* (Fig. 84*A*), *O. bisulcata* (Fig. 86*B*) and *O. fossulata* (Fig. 86*D*) also form a compact group of close relatives, as they share the nearly straight anterior margin of the frons, with only a small median notch; but there are some minor, though definite differences between them; it is, moreover, of interest that these 3 species have retained traces of the suture which originally divided the lunula from the frons proper, although the traces are very faint in *O. fossulata*.

1. Basal tergal sclerite of abdomen at apex with a median triangular notch in ♂, divided into 2 broad median lobes in ♀. First basal cell short and wide, distinctly bulging before apex; 3rd and 4th longitudinal veins with a row of setulae on both upper and under sides of wing; entire combined anal, 3rd posterior and axillary cells, as well as a narrow adjoining inner area of postaxillary cell, covered on upper surface of membrane with microtrichia, which extend over most of the postaxillary cell on the under surface. Postvertex forming an undivided, smooth sclerite from occiput to ptilinal suture. Wing 7 to 8 mm. long ..... *O. sordida*

   Apical margin of basal tergal sclerite of abdomen either nearly straight or broadly and evenly curved inward in both sexes. First basal cell long and narrow, nearly parallel-sided, not bulging apically; 4th longitudinal vein bare throughout; hind third to half of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia on upper surface of membrane 2

2. Upper orbits prominent, nearly or fully as long as upper width of inner orbits; occipital margins of upper orbits and of postvertex strongly produced and separated on each side by a deep concave notch. Postvertex extending from occiput to ptilinal suture, but divided about mid-length by a slight transverse depression into an upper, smooth and a lower, duller area. Third longitudinal vein partly setulose (at least near the tip) on upper side of wing 3

   Upper orbits low, decidedly shorter than upper width of inner

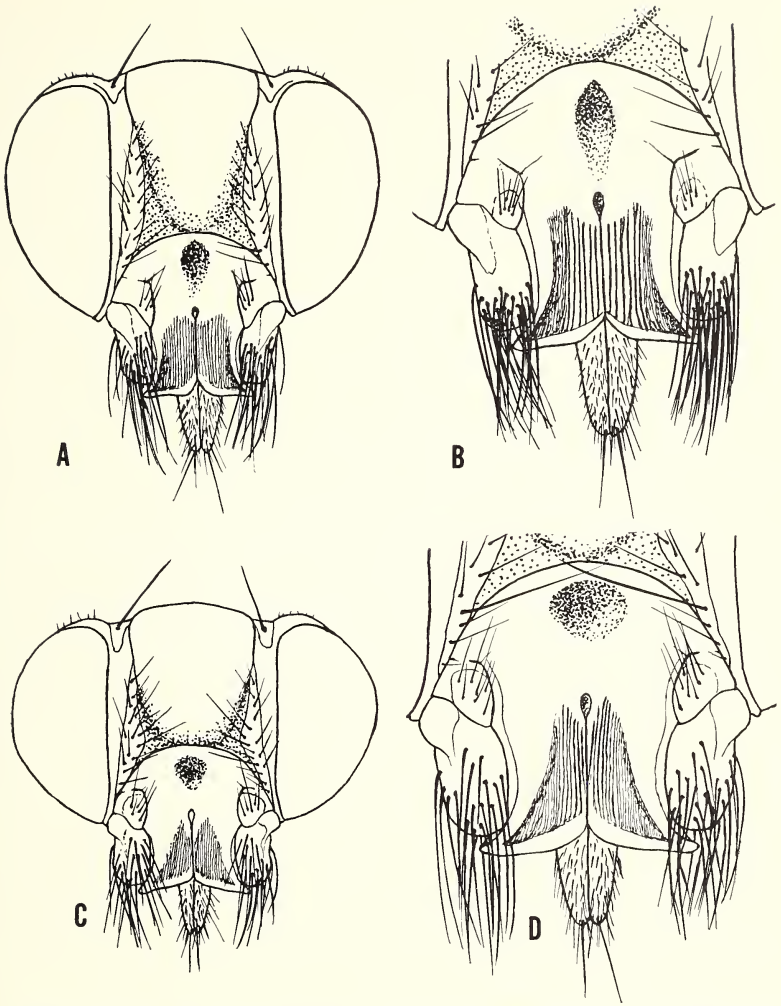

Fig. 86. **A**, head of *Olfersia bisulcata* Macquart, ♀, Turrialba, on *Cathartes a. aura;* **B**, frontal area and antennae of same; **C**, head of *O. fossulata* Macquart, ♀, Arica; **D**, frontal area and antennae of same.

orbits; occipital margins of upper orbits and of postvertex slightly or scarcely produced, separated on each side by very shallow inward curves 4

3. Occipital margin of postvertex somewhat more produced than that of the upper orbits. Anterior basal cross-vein (at tip of 2nd basal cell) very slanting, the upper apical angle of the cell acute; posterior area of combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia on both under and upper surfaces of membrane. Wing 7 to 9.5 mm. long. *O. spinifera*

Occipital margins of postvertex and of upper orbits about equally produced. Anterior basal cross-vein (at tip of 2nd basal cell) more nearly vertical, the upper apical angle of the cell almost square; entire combined anal, 3rd posterior and axillary cells, as well as entire postaxillary cell, without microtrichia on upper surface only, the under surface of the membrane with microtrichia. Wing 6.5 to 8 mm. long ..... *O. aenescens*

4. Second basal cell short; second section of 4th longitudinal vein at least $1\frac{1}{2}$ times as long as first section of 5th; 3rd longitudinal vein partly setulose on upper side of wing (at least near the tip). Postvertex an almost continuous smooth sclerite from occiput to ptilinal suture, only the sides of the lower portion somewhat duller. Wing 7 to 8.5 mm. long ..... *O. bisulcata*

Second basal cell long; second section of 4th longitudinal vein at most $1\frac{1}{3}$ times as long as first section of 5th (sometimes about the same length) 5

5. Third longitudinal vein setulose throughout on upper side of wing (also basally). Interocular face at its narrowest about $1\frac{1}{2}$ times as wide as an eye; postvertex a continuous, nearly uniformly smooth sclerite from occiput to ptilinal suture. Wing 7 to 9 mm. long ..... *O. fumipennis*

Third longitudinal vein bare or at most with a few minute setulae on apical section only 6

6. Interocular face $1\frac{2}{3}$ times as wide as an eye; postvertex an undivided, nearly uniformly smooth sclerite from occiput to ptilinal suture. Wing 7.5 to 9 mm. long. *O. fossulata*

Interocular face about $1\frac{1}{4}$ times as wide as an eye, rarely somewhat more. Postvertex extending from occiput to ptilinal

suture, but divided by a slight transverse depression into an upper, smooth and a lower, duller area. Wing 6 to 7.5 mm. long ..... *O. coriacea*

Olfersia spinifera (Leach)

Figs. 85*A–B* and 87*A–I*

[*Hippobosca nigra* Osbeck, 1757, Dagbok öfver en Ostindisk Resa (1750–1752), p. 297 (Ascension I.: on "*Pelecanus aquilus*" = *Fregata aquila*). Pre-Linnean and without description].

[*Ornithomyia pelecani liscatoris* v. Olfers, 1816, De Vegetativis Animatis in Corporibus Animatis Reperiundis, **1**, p. 103 (Ascension I.); with "*Hippobosca nigra* Osbeck" as synonym; without description. *Nomen nudum*].

Feronia spinifera Leach, 1817 (September), Gen. Spec. Eproboscideous Ins., pp. 6 and 11; Pl. 26, figs. 1–3 [1818, Mem. Werner. Nat. Hist. Soc., Edinburgh, **2**, pt. 2, pp. 552 and 557; Pl. 26, figs. 1–3] (no sex; no host; no locality. Type probably lost, not now at Brit. Mus.); 1817 (November), Brewster's Edinburgh Encyclopaedia, **12**, pt. 1, p. 162 (no specific description, but with a brief generic diagnosis).

Olfersia spinifera Wiedemann, 1830, Aussereurop. Zweifl. Ins., **2**, p. 607 (with new description. Doubtfully from Cape of Good Hope). Speiser, 1899, Wien. Entom. Zeitg., **18**, p. 202. Aldrich, Insecutor Inscitiae Menstruus, **11**, p. 77 and 78. Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (Galapagos: Tower I., on *Fregata* "*aquila*" [= *F. m. magnificens*]). Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366 (Galapagos: Floreana [or Charles] I., on *Fregata* sp.). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 103; 1933, Proc. California Ac. Sci., (4), **21**, No. 11, p. 132. Thompson, 1938, Ent. Mo. Mag., **74**, p. 44. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 319 and 320; 1940, Rev. Acad. Colombiana Ciene. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, No. 11, pp. 271 and 273, figs. 3*a-b*. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 2, p. 121 (Puerto Rico: Mona I. and Mayagüez, on *Fregata magnificens rothschildi*). Guimarães, 1945, Arq. Museu Paranaense, **4**, pt. 7, p. 180 (Brazil: Guaraqueçaba, State Paraná, on *Fregata magnificens rothschildi*). Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix: on *Fregata magnificens rothschildi*). Ramos, 1947, *Op. cit.*, **30**, (for 1946), pt. 1, p. 62 (Puerto Rico: Mona I., on *Fregata magnificens rothschildi*). Wolcott, 1951, *Op. cit.*, **32**, (for 1948), pt. 3, p. 530.

Feronia (*Olfersia*) *spinifera* Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 229 (synonymizes *Olfersia courtilleri* Courtiller).

Pseudolfersia (*Feronia*) *spinifera* Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (synonymy of *O. unicolor* Walker; in part: only specimen from Ascension I.; not the specimen from Pará, on *Catharistes urubu*, which was *O. bisulcata*).

Pseudolfersia spinifera Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, pp. 146–149 and 179 (synonymizes *O. courtilleri* "Fairmaire" and probably also *O. unicolor* Walker; claims that Leach's type came from Java, but does not say why). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, pp. 244, 246, 303 and 304; 1909, Deutsche Südpolar-Expedition, **10**, (Zool., 2), pt. 4, p. 531 (Ascension I.: on *Fregata aquila*); 1909, Jl. f. Ornithologie, **57**, p. 101. Schaeffer, 1914, Brook-

lyn Inst. Mus., Sci. Bull., **2**, pt. 4, p. 93 (near the rocks of Trinidad Islet, South Atlantic Ocean). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 179 and 188; Pl. 27, fig. 2 (Brazil: Rio de Janeiro, on *Fregata aquila*). Brèthes, 1918, Rev. Chilena Hist. Nat., **22**, p. 122 (Peru: Lima; a doubtful record). Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 196 (in part: Mexico: Cape San-Lucas, Baja California, ♂ on *Fregata aquila;* not the figures, which are *O. aenescens*). Luederwaldt and Pinto da Fonseca, 1922, Rev. Mus. Paulista, **13**, pp. 480 and 497 (Ilha dos Alcatrazes, off the coast of Brazil: common in nests of *Fregata minor*). Gowdey, 1926, Dept. Agric. Jamaica, Ent. Bull. **4**, pts. 1–2, p. 90.

Olfersia sp. Howard, 1890, Proc. U.S. Nat. Mus., **12**, No. 771, (for 1889), p. 206 (3 miles from Abrolhos Is., off Brazil, flying on board ship; specimen seen by me at U.S. Nat. Mus.).

Ornithomyia unicolor Walker, 1849, List Dipt. Brit. Mus., **4**, p. 1144 (no sex. Jamaica, on *Fregata aquila*. ♂ ♀ at Brit. Mus., the ♂ now labelled as type from *Fregata aquila*). Osten Sacken, 1858, Cat. Dipt. North America, p. 86; 1878, Smithson. Misc. Coll., No. **270**, p. 213. Johnson, 1894, Proc. Ac. Nat. Sci. Philadelphia, p. 281. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 190 (copy of description).

Olfersia courtilleri "Fairmaire" Courtiller, 1853, Ann. Soc. Linn. Dépt. Maine-et-Loire, Angers, **1**, p. 196; Pl. 15 (no sex. France: Saumur, on *Fregata* ["*Tachypetes*"] *minor*. Puparium. [Both Bigot, 1885, and Speiser, 1902, saw the type and recognized in it *O. spinifera*. Bigot misspelled the name "*courtilieri*"]. Type ♂ from Bigot Coll. now in J. E. Collin Coll.).

Olfersia curtilleri Rondani, 1879, Bull. Soc. Ent. Italiana, **11**, p. 23 (misspelling of *courtilleri*).

Olfersia sulcifrons C. G. Thomson, 1868, Eugenies Resa, **2**, Zool., pt. 1, Insekter, p. 611 (no sex; no host. Panama: Type in Stockholm Mus.). Osten Sacken, 1878, Smithson. Misc. Coll., No. **270**, p. 149.

Pseudolfersia sulcifrons Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 149. Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656.

Pseudolfersia spinifera var. *sulcifrons* Speiser, 1904, Zeitschr. Syst. Hym. Dipt., **4**, p. 83 (type); 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Ornithomyia sp. Dahl, 1892, Ergebn. Plankton-Exped., **1**, pt. A, p. 206 (Ascension I.: on *Fregata aquila*).

Distribution and Specimens Examined. United States. Florida: Sebastian, Indian River Co., on *Pelecanus o. occidentalis* (A. Wetmore). — Louisiana: Quarantine, Plaquemines Parish, on *Fregata magnificens rothschildi* (C.L. Sperry).

Mexico (recorded by Ferris and Cole, 1922).

British Honduras: Turneffe Is., on *Fregata magnificens rothschildi* (S.M. Russell).

Panama (recorded by Thomson, 1868): Taboguilla I., C.Z. (T. Hallinan).

Antilles. Bahamas: Great Salt Cay, on *Phalacrocorax auritus floridanus* (Am. Mus. Nat. Hist.); Six Hills Cay, Caicos Is., on *Fregata magnificens rothschildi* (H.S. Peters). — Cuba: Matanzas, Prov. Matanzas, on *Fregata magnificens rothschildi*

(C. Sanchez). — Isle of Pines: Bird I., on *Fregata magnificens rothschildi* (G. Link). — Cayman Islands: Little Cayman, on *Fregata magnificens rothschildi* (H.S. Peters). — Jamaica: (recorded by Walker, 1849, as *unicolor*): ♀ ♂, the ♂ type of *unicolor*, on *Fregata aquila* (P.H. Gosse. — Brit.Mus.); North East Cay and Middle Cay, Pedro Cays, on *Fregata magnificens rothschildi* (C.B. Lewis); South West Cay, Drunkenman's Cay and Port Royal Cay, Pedro Cays, on *Fregata magnificens rothschildi* (R.P. Bengry). — Puerto Rico (recorded by Wolcott, 1941, 1951; Ramos, 1947): Mayagüez, on *Fregata magnificens rothschildi* (J.A. Ramos) and on *Pelecanus o. occidentalis;* Mona I., on *Fregata magnificens rothschildi.* — St. Croix (recorded by Beatty, 1947): on *Fregata magnificens rothschildi* (H.A. Beatty).

Brazil (recorded by Howard, 1890; Schaeffer, 1914; Lutz, Neiva and da Costa Lima, 1915; Luederwaldt and Pinto da Fonseca, 1922; Guimarães, 1945): Rio de Janeiro, on *Fregata aquila* (Ad. Lutz. — Specimen recorded in 1915, now at U.S.Nat. Mus.); Trinidad Islet, off Brazil, 20° 30′ S., 29° 20′ W. (R.C. Murphy; also received from P. Wygodzinsky); 3 miles off Abrolhos Is., coast of Bahia, 18° S. (Albatross Exped. — Recorded by Howard, 1890); Ilha da Queimada Grande, State São Paulo, on *Fregata magnificens rothschildi* (E. Dente); Ilha dos Alcatrazes, State São Paulo, on *Fregata magnificens rothschildi.*

Ascension I. (recorded by Osbeck, 1757; Dahl, 1892; Speiser, 1909): (H. Giammarco).

?Peru (recorded by Brèthes, 1918, but identification doubtful).

Galapagos (recorded by Johnson, 1924; Curran, 1932): Darwin Bay, Tower I. (M. Willows, Jr.; W.H. Osgood and D. Lambert); Tower I., on *Fregata minor ridgwayi* (J.P. Chapin) and on *Fregata m. magnificens* (W. Beebe; W.S. Brooks); Post Office Bay, Charles I. [or Floreana] (A. Wollebaek); Conway Bay, Indefatigable I., on *Fregata m. magnificens* (J.P. Chapin); Kicker Rock, on *Fregata* sp. (H.A. Pilsbry); Wenman I.

Like its breeding hosts, the frigate birds, *O. spinifera* is nearly cosmopolitan over the tropical seas. In the Old World I have seen it from Christmas I. (Indian Ocean, 10° 23′ S., 105° 43′ E.), Aldabra I. (specimens recorded by Scott, 1914, p. 162, seen at Cambridge Univ. in 1951), the Philippines (Cavilli I., on *Fregata aquila.* — Stanford Univ.), the coast of New South Wales, the Solomons, Tuamotus, Gilberts, Marquesas, Fijis, and Hawaiian Islands. The few records outside the intertropical zone are clearly

stray occurrences. The northmost localities in the New World are in Louisiana (Quarantine, 29° 15′ N.) and Florida (Sebastian, 27° 45′ N.). There are also two European records, from Saumur, Central France (Courtiller, 1853), and from Tiree I., Inner Hebrides, Scotland (Stephen, 1953), both from stray *Fregata magnificens rothschildi*. In the Southern Hemisphere, it extends to just south of the Tropic of Capricorn on the coast of Brazil and of New South Wales.

Known American Hosts of *O. spinifera* (verified individual records in parentheses). Pelecaniformes (21): *Fregata aquila* (2); *F. m. magnificens* (2); *F. magnificens rothschildi* (13); *F. minor ridgwayi* (1); *Pelecanus o. occidentalis* (2); *Phalacrocorax auritus floridanus* (1).

Most of the reliable records in the Old World are from *Fregata aquila* and *F. minor*. The recorded occurrences on pigeons (Janson in Ormerod, 1889, p. 61; Froggatt, 1900, p. 1091; Gedoelst, 1911, p. 245), noddies (Schiner, 1868, p. 373), boobies (Ricardo, in Forbes, 1903, Natural History of Sokotra, p. 376; Austen, 1903, p. 265), albatrosses (Ferris and Cole, 1922, p. 196), shearwaters (Ferris, 1927*c*, p. 220), tropic-birds (Falcoz, 1930, p. 45), and diurnal birds of prey (Austen, 1903, p. 265; Ferris and Cole, 1922, p. 196; Dunn, 1934, p. 175) were all based on misidentifications, usually of *Olfersia aenescens* Thomson, *O. sordida* Bigot, or *O. bisulcata* Macquart.

Bionomics. I regard the true *O. spinifera* as a strictly specific parasite of the circumtropical frigate or man-of-war birds (*Fregata*), which are its only regular breeding hosts. The very few specimens actually found on pelicans and cormorants were no doubt strays, acquired temporarily when these birds were nesting or roosting in rookeries close to frigate birds. F.W. Jones (1909, pp. 150–151) noted that, on Cocos Keeling Atoll (Indian Ocean), the flies swarmed over the *Fregata* nestlings and were seen crawling over the bushes nearby.

The puparium of *O. spinifera* was figured by Courtiller, who described it as follows (1853, as *O. courtilleri*): "Puparium large, oval, very short, thick, hirsute with small stiff hairs, except on the operculum [actually the posterior spiracular area] which bears two somewhat rugose protuberances [the polypneustic lobes]. When voided the puparium was a beautiful white except for the two protuberances, which were black; gradually the white color turned brownish and within 5 or 6 hours the entire puparium became brown." Dr. C.B. Lewis (*in litt.*, 1950) found *O. spinifera*

extremely numerous around nests of frigate birds on the Middle Cay of the Pedro Group near Jamaica. In a nest he collected and brought back to the Jamaica Science Museum, and which was searched for parasites by Mr. R.P. Bengry, puparia of *Olfersia* were found underneath the platform of lime and attached to the twigs. In June, 1952, Mr. K.L. Maehler obtained on Johnston I., Hawaiian Is., from flies associated with frigate birds, 3 puparia used for the following description. The puparium (Fig. 87*I*) is broadly oval, almost elliptical seen from above, about 4 mm. long, 2.8 mm. wide and 2.5 mm. thick. It is mostly covered with numerous, irregularly spaced stiff hairs, each ending at the very slender tip in a pair of minute, divergent barbs, similar to those of *O. aenescens* (Fig. 88*J*). The surface in addition is densely pitted. Both the hairs and pits are lacking over an anterior circular ring which delimits the future cap pushed off by the emerging adult. The two respiratory polypneustic lobes of the respiratory cap at the posterior end are separated by a notch deeper and narrower than in *O. aenescens;* their surface is bare, but densely and minutely punctate. Each polypneustic lobe bears 40 to 45 respiratory pores, each on a low and fairly large mound.

To the two cases of infestation with mites mentioned in Pt. I (p. 159) the following may be added.

3. Two ♂ from Nengo Nengo I., Tuamotu Group (Pacific Ocean), on *Fregata* sp., each carried a ♀ mite surrounded by eggs: in one fly on the side of the left basal laterotergite of the abdomen; in the other, on the right side of the thorax, in the deeply grooved anepisternum, below the prothoracic spiracle.

4. One ♂ from St. Croix I., on *Fregata magnificens rothschildi*, carried a ♀ mite, without eggs, on the outer side of the mid left tibia.

5. One ♂ from Mayagüez, on *Fregata magnificens rothschildi,* carried a ♀ mite with egg cluster on the upper side of the left mid femur, at about mid-length.

6. One ♂ from Canton I., Gilbert Group (Pacific Ocean), carried an egg cluster and ♀ mite on the left dorsal side near the tip of the abdomen.

In Part I, I mentioned what is known of the larviposition (p. 194) and host relations (pp. 250 and 316) of *O. spinifera.*

Affinities. The following additional characters of *O. spinifera* may be noted. Interocular face from $1\frac{1}{2}$ to $1\frac{2}{3}$ times the width of an eye in ♀, nearly twice that width in ♂ (Fig. 85*A*). First antennal segment completely separated from the fused frons and

lunula in some specimens, incompletely in others. Palpi relatively long, extending much beyond apical edges of frons. Transverse, shallow depression of postvertex nearly straight, placed close to mid-length. One vertical bristle on each side of postvertex. Interantennal part of frons (Fig. 85*B*) very finely rugulose over a narrow triangular area of inner half only; free, divergent apices separated by a deep triangular notch, the narrowed, outwardly directed points rather sharp, the surface very shallowly grooved throughout. Mesonotum on each side with 3 small patches of dull pruinosity, behind posthumeral suture, along transverse mesonotal suture and near scutellum; anterior margin with three broad, arched notches, to receive the produced postvertex and upper orbits. First longitudinal vein ending about opposite anterior cross-vein; 2nd longitudinal ending nearly twice as far from tip of 1st as from tip of 3rd. Longitudinal suture extending over nearly entire sternum; metasternum and mesofurcasternum completely divided by a distinct suture. Abdomen of ♀ (Fig. 87*C*) with large basal sclerite of normal shape, the hind margin broadly curved inward medially, where it is followed by a short, transverse, ribbon-like plate in which a pair of rugulose plates are more or less set off in the middle; preäpical dorsal sclerite transverse, rather short, with an irregular row or group of 7 or 8 long bristles on each side near hind margin; lobes on rim of anal sclerite (before genital sclerite; Figs. 87*E–F*) prominent, triangular and bluntly pointed in flies preserved in alcohol (much narrower and bluntly finger-shaped in dry specimens; Fig. 87*F*). Abdomen of ♂ (Fig. 87*D*) with ribbon-like anterior dorsal sclerite (behind the fused laterotergites) much smaller than in ♀, and with the preäpical dorsal sclerite larger; the setigerous lobes at sides of aedeagus appear somewhat narrower and more finger-shaped than in *O. aenescens* (particularly when spread out in dry, pinned flies). The species averages slightly larger than *O. aenescens*, the wing being 7 to 9.5 mm. long; but some flies of both species are the same size.

The earliest reference to the fly of frigate birds was by Osbeck (1757). He mentioned an insect occurring on "*Pelecanus aquilus*" at Ascension I., which he called "*Hippobosca nigra*". The name is pre-Linnaean and, moreover, was published without a description. v. Olfers (1816) listed Osbeck's name in the synonymy of his "*Ornithomyia pelecani liscatoris,*" but he neither saw a specimen, nor gave a description; so that his names are also *nomina nuda.*

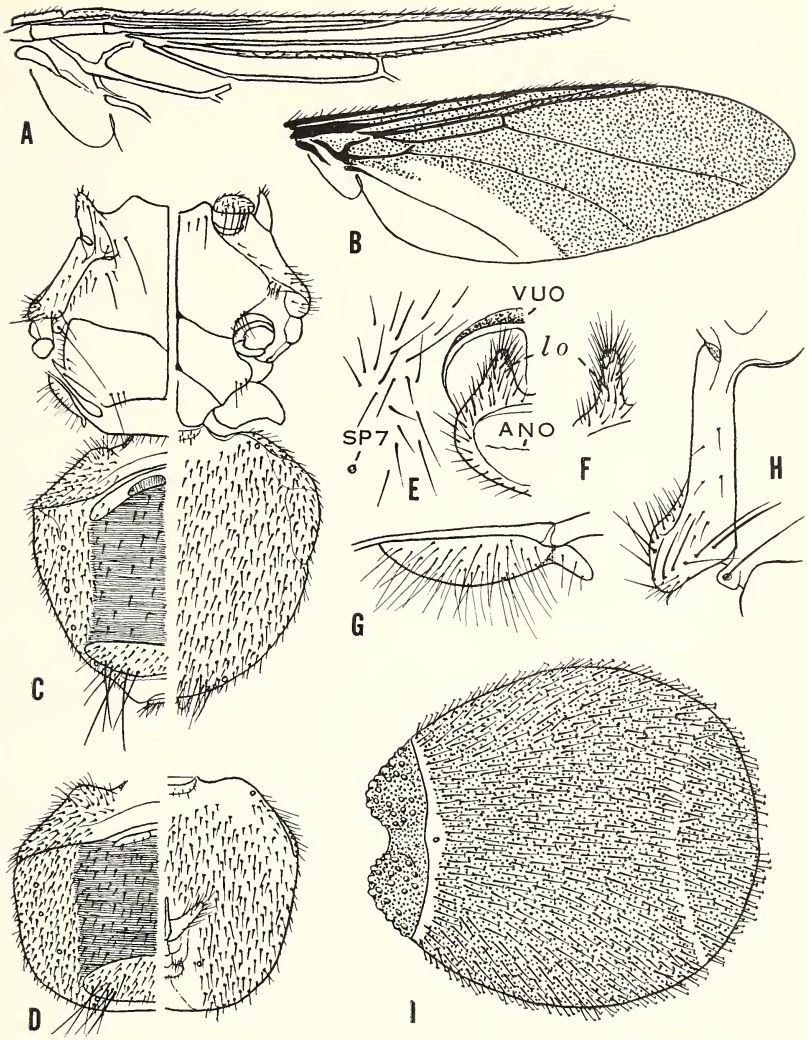

Fig. 87. *Olfersia spinifera* (Leach). **A**, anterior area of wing, the microtrichia omitted, ♀, Taboguilla I.; **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally, ♀, Conway Bay, Indefatigable I., on *Fregata m. magnificens;* **D**, abdomen dorsally and ventrally, ♂, Tower I., on *Fregata minor ridgwayi;* **E**, one side of ventral ano-genital area, ♀, Conway Bay, drawn from fly in alcohol: *ANO*, anal opening; *lo*, lobe on rim of anal sclerite; *SP?*, 7th abdominal spiracle; *VUO*, vulvar opening; **F**, lobe on rim of anal sclerite, ♀, Lau, Fiji Is., drawn from dry fly; **G**, left metanotal pleurotergite, ♂, Canton I., Pacific Ocean; **H**, dorsal aspect of left anepisternum, ♀, Taboguilla I.; **I**, puparium from fly on *Fregata* sp., Johnston I., Pacific Ocean.

Original description of *F. spinifera:* "F. piceo-atra, alis obscuris; angulo anali subhyalino nitente, thorace angulis antice utrinque spina acuta armato. Caput nigrum: oculi rufi; labium albidum: vagina picea. Thorax piceo-ater, antice spina acuta utrinque armatus: pectus piceum: alae obscurae angulo anali subhyalino nitente: pterigostea picea; limbalibus basi pallidis: pedes supra picei, subtus testaceo-picei; ungues atra." The type, described from MacLeay's collection, has not been seen by any later author and presumably is lost. The description mentions no character now regarded as specific in *Olfersia* and could apply as well to *O. aenescens* as to the species from *Fregata* usually called *spinifera.* Leach's original figures agree in some respects better with *O. aenescens:* the occipital margins of postvertex and upper orbits are drawn about equally produced behind, while the cross-vein closing the second basal cell is shown vertical. It is doubtful, however, whether the drawings can be fully trusted for such details. Speiser (1902) gave the first recognizable description of *spinifera,* based on a fly from a frigate bird of Laysan I. and I have followed his interpretation of the name. If the name *spinifera* were eventually rejected for the frigate bird parasite, *unicolor* Walker should be used instead for it.

Original description of *O. unicolor:* "Nigro-picea, pedibus piceis, alis fuscis. Body, including the mouth and appendages, pitchy-black: head and chest shining: head smooth: eyes pitchy; the facets rather large: chest finely punctured: abdomen dull: legs pitchy, clothed with short black hairs and bristles; claws black: wings brown; wing-ribs and fore border veins pitchy; the other veins dark tawny: Length of the body 3½ lines [= 7.4 mm.]; of the wings 9 lines [= 19 mm., the wing span]." The type series consisted originally of three specimens, now at the British Museum, where I recognized them as *O. spinifera* in 1951, as Austen (1903) had done before. More recently, Dr. F.I. van Emden confirmed at my request that the specimen now marked as the "type" is a male labelled "Jamaica, Gosse, from *Fregata aquila,* 47.62;" its wing, measured by Dr. G.B. Fairchild, is 9.5 mm. long. Another specimen is a female, labelled as the first (47.62), with a wing length of 9.6 mm. The third fly, also a female, labelled only "Jamaica, Gosse, 46.84," has the wing 10.1 mm. long; whether or not this is the fly mentioned by Walker as taken on "*Ephialtes grammicus*" remains uncertain; but the indication of this owl as the host was certainly erroneous.

Original description of *O. sulcifrons:* "Nigro-aenea, subtus cum pedibus sordide testacea, thorace margine antico 3-sinuato, callo humerali pallido, spinoso-producto; alis griseo-hyalinis, nervis nigro-piceis, transverso-ordinario fere ante postcostae exitum sito. Long. 8 (cum alis 13) mil. Praecedenti [*O. aenescens* Thomson] simillima, frontis sulco transverso aeque ab epistomate ac a margine postico remoto, alis obscurioribus, costae abscissa 2:a 3:a multo longiore, nervo transverso-ordinario fere ante postcostae exitum sito, cellula humerali nervo obliquo occlusa, tarsis articulo 5:o magis dilatato satis superque distincta." This description mentions several of the distinctive, specific features and the type, which I examined in 1932, agrees in every respect with what is here called *O. spinifera.*

Original description of *O. courtilleri* (translated from the French): "Length, from head to tip of wings, 14 mm. Very dark brown, shiny and somewhat bronzy above; head very smooth and shiny; a transverse depression between the eyes and beneath it a small pit in which ends the groove dividing the epistome [frons]; antennae and beak hairy. Thorax on each side of the anterior margin with a strong russet tooth. On the sides, below, a depression to receive the femora at rest; also the fore coxae are silky and serve as cushions to receive the head when this is pressed against the body; side corners of the thorax prominent, but rounded off and with a tuft of setae; wings large, smoky, with dark veins. Legs robust, the hind legs very long, blackish brown, dirty russet beneath." The accompanying figure is rather poor and not reliable for the details of the head and wing venation. The type was acquired by

Bigot and is now in the J. E. Collin collection. Both Bigot (1885) and Speiser (1902), who also saw it, recognized that it was the cosmopolitan parasite of frigate birds. Mr. Collin compared it at my request with Bigot's type of *O. erythropsis*, and sent me some notes reproduced in the discussion of *O. aenescens*. I was recently (1951) able to study it myself and to establish that it is a male.

Olfersia aenescens C.G. Thomson

Figs. 21, 84*C*, 85*C*, and 88*A–J*

Olfersia aenescens C.G. Thomson, 1868, Freg. Eugenies Resa, **2**, Zool., pt. 1, Ins., Häft 12, Dipt., p. 610 (no sex; no host. Keeling I., Indian Ocean. Type at Stockholm Mus.). J. Bequaert, 1933, Psyche, **40**, p. 105. Thompson, 1938, Ent. Mo. Mag., **74**, p. 43. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, pt. 4, p. 320; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **14**, No. 11, pp. 271 and 277, figs. 4*a–b*. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 2, p. 121. Beatty, 1947, *Op. cit.*, **28**, (for 1944), pts. 3–4, p. 154 (St. Croix I., on *Sula l. leucogaster*). Wolcott, 1951, *Op. cit.*, **32**, (for 1948), pt. 3, p. 530. J. Bequaert, 1951, Bull. Brooklyn Ent. Soc., **46**, p. 49.

Pseudolfersia aenescens Speiser, 1904, Zeitschr. Syst. Hym. Dipt., **4**, p. 83 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 302.

Olfersia erythropsis Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 239 (no sex; no host. New Caledonia. Type ♂ from Bigot Coll., now in J.E. Collin Coll.). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 103; 1933, Proc. California Ac. Sci., (4), **21**, pp. 132 and 133. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix I., on *Sula d. dactylatra*).

Pseudolfersia erythropsis Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 165 (type).

Pseudolfersia diomedeae Coquillett, 1901, Proc. Washington (D.C.) Ac. Sci., **3**, p. 379 (no sex. Galapagos: Albermarle I., on *Diomedea irrorata*. Holotype ♂, No. 4431, and 2 ♂ paratypes now at U.S. Nat. Mus.; 1 ♂ paratype at Stanford Univ.). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Olfersia diomedeae Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366. Wolcott, 1936, Jl. Agric. Univ. Puerto Rico, **20**, pt. 1, p. 392 (Puerto Rico: Desecheo I., on *Sula l. leucogaster*).

Pseudolfersia spinifera Johnson, 1908, Psyche, **15**, p. 80 (in part: only specimens from Bahamas, on *Sula l. leucogaster*). Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 196 (in part: only paratype ♂ of *diomedeae* from Albemarle I.), figs. 13 and 14*A–C* (drawn from ♂ paratype of *diomedeae*). Not of Leach, 1817.

Olfersia fossulata Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (in part: only specimens from Bahamas, on *Sula l. leucogaster*). Not of Macquart, 1843.

Distribution and Specimens Examined. Mexico: Isabel I., off Pacific Coast, State Nayarit, on *Sula nebouxi* (J. Garth); Clarion I., Revilla Gigedo Group (Pacific Ocean), on 2 *Sula dactylatra californica* (J. Kieffer; W.A. McDonald and Blodget).

Panama: without more precise locality, on *Sterna fuscata crissalis*, June 16 (W. Beebe).

Cocos I.: on *Sula leucogaster brewsteri* (W. Beebe).

Antilles. Bahamas (recorded by Johnson, 1908, 1924): Mangrove Cay, Andros I., on *Sula l. leucogaster* (specimen referred by Johnson to *spinifera* in 1908 and to *fossulata* in 1924). — Puerto Rico (recorded by Wolcott, 1936, 1951): Desecheo I., on *Sula l. leucogaster* (S.T. Danforth); Mona I., on *Sula l. leucogaster, Sterna anaethetus melanoptera,* and *Anoüs s. stolidus* (W. Pippin). — St. Croix (recorded by Beatty, 1947): on *Sula l. leucogaster* and *Sula d. dactylatra* (H.A. Beatty).

Brazil: Fernando de Noronha I. (MacCreary); Trinidad Islet, 20° S. (R.C. Murphy).

Galapagos (recorded by Coquillett, 1901, as *diomedeae*): Albemarle I., on *Diomedea irrorata* (types of *diomedeae*); Indefatigable I. (M. Willows, Jr.); Hood I., on *Diomedea irrorata* (F.X. Williams); Tower I., on *Sula sula rubripes* (W. Beebe).

Ascension I.: common (D.E. Hardy; W. Ford; J.R. Fisher).

O. aenescens is probably tropicopolitan in the Atlantic, Indian and Pacific Oceans. There are many records from the Pacific area (J. Bequaert, 1941*b*). I have also seen it from Establishment I., Cargados Carajos Group, 16° 30′ S., 59° 40′ E. (specimens listed as *O. spinifera* by H. Scott, 1914, p. 162); Socotra (Simony); St. Paul's Rocks, 38° 40′ S., 77° 34′ E.; northeast coast of Australia (on *Sula australis*); and Boa-Vista I., Cape Verde Is. (L. Fea). It is a truly oceanic insect, which never strays far inland. The northmost record is Isabel I., off the west coast of Mexico (22° N.); the southmost, St. Paul's Rocks in the Indian Ocean (38° 40′ S.).

Known American Hosts of *O. aenescens* (verified individual records in parentheses). Procellariiformes (2): *Diomedea irrorata* (2). Pelecaniformes (12): *Sula d. dactylatra* (3); *S. dactylatra californica* (2); *S. l. leucogaster* (4); *S. leucogaster brewsteri* (1); *S. nebouxi* (1); *S. sula rubripes* (1). Charadriiformes (3): *Anoüs s. stolidus* (1); *Sterna anaethetus melanoptera* (1); *S. fuscata crissalis* (1).

Bionomics. *O. aenescens,* a specific parasite of oceanic fish-eating birds, has been taken on a variety of hosts. The evidence is as yet insufficient to decide whether or not any of these are preferred as true breeding hosts. In America it occurs most often on boobies (*Sula*) and more rarely on albatross (*Diomedea*), noddy terns (*Anoüs*), and sooty terns (*Sterna*). Elsewhere, particularly in the Pacific area, it is common on tropic-birds (*Phaëthon*), but is found also on petrels (*Pterodroma*), shearwaters (*Puffinus*), and noddies (*Anoüs*). All these sea birds are so-called "swimmers", with similar habits of feeding at sea and nesting or roosting in

populous colonies on oceanic islands. In this case the number of verified host records listed above gives no idea of the frequency and density of the infestations. In the rookeries nearly all young and adult birds carry some flies, as shown in Fig. 21 (Pt. I, p. 251).

O. aenescens has not been taken thus far on a live host in the continental waters of the United States. However, on two occasions a dead male was found by the U.S. Public Health Service, after fumigation, inside aircraft arriving from overseas at Miami Beach, Florida; both planes had last touched land in Puerto Rico, one having started from Accra, Gold Coast, and the other from Trinidad. A dead fly was also found at San Francisco on a plane arriving from across the Pacific (Sept. 7, 1937). Other specimens were taken by F.C. Hadden at Midway Island, in the Pacific, on 4 commercial planes eastbound from Hawaii. I have also seen a ♂ taken at Guam on a plane eastbound to the Philippines (Dec. 17, 1938). The frequent occurrence of *O. aenescens* on aircraft may be explained by the roosting and nesting habits of the hosts. Dr. J.P. Chapin pointed out that sooty terns in particular nest in colonies precisely on the flat, open areas suitable for airstrips at mid-ocean stopping places. During the second world war, at Ascension I., in the southern Atlantic, sooty terns habitually came in at dusk to roost near the end of runways on the airfield, where eventually they would start nesting. The birds were a serious hazard there because of their habit of flying in a cloud ahead of departing planes (J.P. Chapin, 1946, Natural History, New York, **55**, pp. 313–319). Sooty terns presented the same problem on the airfield at Johnston I. and probably elsewhere in the Pacific. The close proximity of airfields to colonies of sooty terns or other suitable bird hosts accounts for *O. aenescens* entering planes landing at such places, where the planes remain open for some time. It is, moreover, possible that when a closed plane hits a flock of birds after taking off, killing some of them in the process, a fly might alight on the outside of the moving aircraft and eventually find its way inside. The flattened body and the habit of sliding beneath feathers allow a hippoboscid to enter even very narrow openings (J. Bequaert, 1951*b*).

When *O. aenescens* is abundant in rookeries, feeding mainly on young birds, some of the flies are often observed running over rocks or low vegetation. These flies may be newly emerged adults or gravid females in search of appropriate shelter for larviposition. They are then more exposed to predators than when they are hidden within the bird's plumage. Dr. W.W. Wirth observed spiders

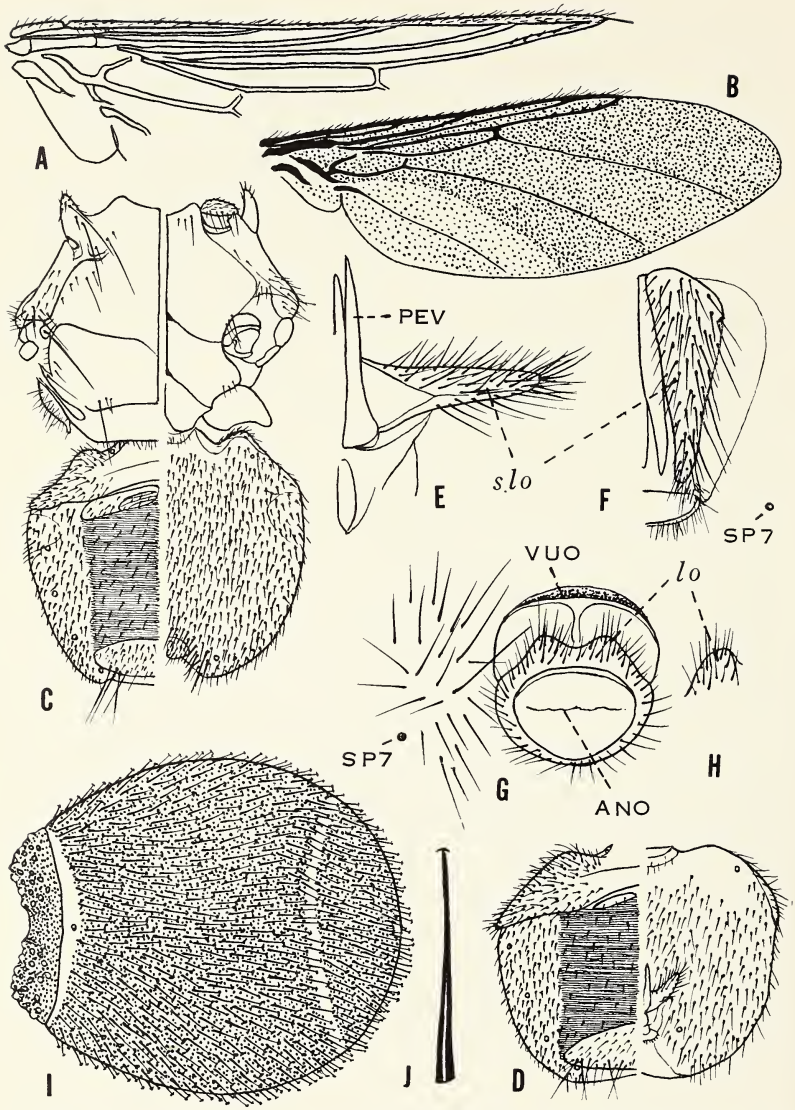

Fig. 88. *Olfersia aenescens* C.G. Thomson. **A,** anterior part of wing, the microtrichia omitted, ♀, Desecheo I., on *Sula l. leucogaster;* **B,** wing of same; **C,** thorax and abdomen dorsally and ventrally of same; **D,** abdomen dorsally and ventrally, ♂, Ponape I., Pacific Ocean, on *Anoüs minutus marcusi;* **E,** one half of ♂ terminalia ventrally in extended condition, Ascension I.: *PEV,* penis valve; *slo,* setigerous lobe at side of genital atrium; **F,** one half of ♂ terminalia ventrally in folded condition, Ponape I., on same host: *slo,* setigerous lobe at side of genital atrium; *SP7,* 7th abdominal spiracle; **G,**

capturing such flies in the open on Rabbit I., off Oahu (*in litt.*, November 7, 1946; see Part I, p. 131).

The flies alluded to in the following passage of R.C. Murphy's "Oceanic Birds of South America" (1936, vol. 2, p. 850), were presumably *O. aenescens*, although no specimens were available for naming. "All of the nesting white boobies [*Sula dactylatra*] at La Plata [off the coast of Ecuador] had curious blackish blue, cloudy spots on the outer white feathers of their throats, just below the pouch. Sometimes there were half a dozen of these, and while I was examining them on living birds I found, to my astonishment, that the spots changed their position and shape. Closer inspection showed that the marks were made by hippoboscid flies, buried just under the surface of the snowy feathers so that they were only half veiled. They were present at all times among the feathers of every one of a large number of nesting birds, and always confined to the throat. Possibly they selected this part of the booby plumage as a retreat because it was the only accessible area which afforded shade from the full glare of the equatorial sun."

The following aspects of the bionomics of *O. aenescens* were discussed in Part I: infestation with fungi (Laboulbeniales; p. 141); duration of pupal development (p. 199); and host relations (pp. 222–223 and 250).

Infestation with mites appears to be rare in *O. aenescens*, no cases being recorded thus far. Among the many specimens examined I have only found two females carrying mites, both from St. Croix I. and taken on *Sula leucogaster*. One carried 3 mite clusters: one fixed to the under side of the elbow-shaped vein forming the base of the first basal cell in the left wing; one ventrally near the apex of the abdomen; and one on the under side of the left mid femur, close to the base. The other fly had two clusters: one on the right side of the abdomen, near the apex; and the other dorsally at the anterior margin of the thorax, on the right side in the deep notch between the notum and the occipital margin.

The puparium is as yet undescribed, although Kartman (1949, p. 131) mentioned that he obtained from flies kept in captivity 2

---

ventral ano-genital area, ♀, Ponape I., on same host, drawn from fly in alcohol: *ANO*, anal opening; *lo*, lobe on rim of anal sclerite; *SP7*, 7th abdominal spiracle; *VUO*, vulvar opening; **H**, lobe on rim of anal sclerite, ♀, Ducie I., Pacific Ocean, drawn from dry fly; **I**, full-grown larva from fly on *Sula l. leucogaster*, Raroia Atoll, Pacific Ocean; **J**, one of the anchor-tipped hairs of same.

puparia from which adults emerged later. I have seen a newly-laid, apparently full-grown larva (Fig. 88*I*), dirty-white except for the black respiratory cap, which was found by Mr. J.P.E. Morrison in the plumage of *Sula leucogaster* on Raroia Atoll, Tuamotu Group, Pacific Ocean. This is 4 mm. long, 2.8 mm. wide and 2.5 mm. thick. Its shape is that of the puparia known for other species of the genus and it is likewise covered with erect, stiff hairs, which in this species end in a pair of microscopic divergent barbs, so that the hair is anchor-shaped at the tip. The terminal barbs are so minute as to be easily overlooked and the tips on which they are inserted are often broken, so that many hairs have lost them. The integument is also minutely pitted. Both the pits and the hairs are lacking over a ring-like area corresponding to the future circular seam along which the puparium splits when the adult emerges. The apical notch of the respiratory cap is very broad and shallow. On each half of the cap the respiratory pores are scattered rather irregularly, about 40 to 45 on each half, each on a rather wide but low mound.

According to Gressitt (1955), *O. aenescens* is common on red-footed boobies, *Sula sula rubripes*, at Mokapu Point, Oahu, Hawaiian Is. It is also abundant at Kilauea Point Light Station, Kauai I., from November to February, when "their bites inflict painful, long-lasting sores on the personnel of the station." This is the first mention of the species attacking Man.

Affinities. The main characters separating *O. aenescens* from its close ally, *O. spinifera*, are given in the key. The following additional points may be mentioned. Interocular face about $1\frac{1}{2}$ times the width of an eye in ♀, nearly twice that width in ♂ (Fig. 85*C*). First antennal segment incompletely separated behind from the side of the lunula. Transverse depression of postvertex slightly curved and placed below mid-length. Upper orbits slightly longer than in *O. spinifera*, about as long as greatest width of inner orbits, more distinctly grooved transversely. Frontal area and antennae (Fig. 84*C*) as in *spinifera*. Thorax and abdomen (Figs. 88*C–D*) as in that species; lobes on rim of anal sclerite (Figs. 88*G–H*) low, broadly rounded, not triangular nor finger-shaped. In the ♂ the setigerous lobes at the sides of the aedeagus often appear narrower and more rod-like than in *O. spinifera*, but it seems doubtful that the difference is reliable in every case. The microtrichia of the under surface of the wing membrane in the hind part of the combined anal, 3rd posterior and axillary cells, and in the postaxillary cell (indicated by more spaced stippling in Fig. 88*B*), leave a

narrow bare outer marginal strip in the postaxillary cell as well as in the alula. *O. aenescens* averages smaller than *O. spinifera,* the wing being 6.5 to 8 mm. long.

Original description of *O. aenescens:* "Nigro-aenea, subtus cum pedibus sordide testacea; thorace margine antico 3-sinuato, callo humerali pallido spinoso-producto; alis griseo-hyalinis, nervis nigricantibus, transverso-ordinario pone post costae exitum sito. Long. 6 mill. *O. mexicanae* Macq. affinis. Caput horizontale, postice in sinu thoracis arcte receptum, aeneum, glabrum, nitidum; fronte utrinque setis 2 haud validis, distantibus ornata, sulco transverso ab epistomate minus quam a margine postico remoto; ocellis nullis; epistomate linea subarcuata a fronte discreta, horizontali, canalicula media postice in foveam dilatata, impresso, apice exciso, lobis divaricatis; antennis prope sinum lateralem epistomatis insertis, compressis, haud latis, setulosis; genis ante oculos pallide fuscis, pilosulis; palpis vaginatis compressis, epistomatis apicem superantibus, corneis; oculis maximis glabris, ovalibus, orbita inferiore postice subsinuata. Thorax depressus, aeneus, nitidus, antice 3-sinuatus, impressione transversa pone medium distincta, medio interrupta, callo humerali pallido, setis nonnullis ornato; scutello transverso, apice truncato. Alae longae incumbentes, glabrae, griseo-hyalinae; nervis nigro-piceis, corneis, costali cum ramo submarginali cubiti fere in 4:a posteriore alae parte conjuncto ibique desinente, abscissa 2:a sive mediastina quam postcostali haud longiore, 4:a praecedente sesqui, quam ultima fere triplo longiore; mediastino discreto; postcostali medium alae attingente; cubitalis furca ante apicem cellulae humeralis sita, ramis ut etiam brachiali costae approximatis; brachiali ante furcam cubiti spatio membranaceo interrupto, pone nervum transversum ordinarium obsoletiore, apicem alae haud attingente; humerali pone nervum transversum et anali mox pone originem obsoletioribus: cellula discoidali postice aperta; humerali nervo transverso perpendiculari bene discreta; anali aperta; lobo distincto, halteribus parvis, horizontalibus, clava parva, apice truncata. Abdomen rotundum, thorace latius, opacum, medio nitidulum. Pedes omnes distantes, sordide testacei, sensim longiores, nitiduli; femoribus superne parce nigro-setosis; tibiis compressis, muticis, margine exteriore subarcuato; tarsis tibiis brevioribus, articulis deplanatis, posticis articulo 1:o elongato, 5:o unguiculis validis nigris, 3-dentatis, dente basali pallido, pulvillis majusculis, empodio distincto tenui. Pectus subtus medio planiusculum, nitidum, latera versus aenescens; pleuris dorso ante alas conspicuis pro femoribus anticis recipiendis excavatis; prosterno membranaceo." I studied the type at Stockholm in 1933 and found that it agreed in every structural character with the species I had identified previously as *O. erythropsis* Bigot, which name now becomes a synonym. Speiser (1904) concluded from a study of the type of *aenescens* that, although closely related to *O. erythropsis,* it differed in the shape of the postvertex; but the difference is too slight to be of specific value. In the type of *aenescens* the postvertex is divided by a transverse depression into a short, anterior alutaceous portion and a much longer, posterior, smooth and shiny area, exactly as in the type of *erythropsis.* The shape of the occipital margin and of the basal cell are also the same in both types.

Original description of *O. erythropsis* (French text translated): "Long. 6 mm. Antennis fuscis, fuscovillosis. Fusco nigro, thorace nitido; oculis rufis; humeris flavis; thorace et scutello, utrinque, castaneo obscuro limbatis; tibiis sordide rufis, femoribus, superne, tibiis, intus et externe, tarsis, omnino, obscure fuscis; alis infumatis, venis, costali, longitudinalibus 1–4is omnino, 5a et 6a, usque ad transversas nigras, nigris. Antennae brown, with brownish pilosity; thorax very shiny brownish-black; eyes red; frons with two transverse grooves, a rounded pit placed above the epistome [clypeus]; humeri yellowish; sides of thorax and of scutellum with a dark chestnut border; scutellum seemingly bare; abdomen blackish brown, little shiny; legs dull reddish; femora above and inner and outer margins of tibiae and tarsi blackish; some scattering

brown setae on the femora; wings smoky; costa, entire 1st to 4th longitudinal veins, and 5th and 6th as far as the cross-veins, blackish; 1st cross-vein pale; 2nd longitudinal joining the costa about opposite the 1st cross-vein and far from the 3rd longitudinal; the two basal cells very unequal.'' The type was examined by Speiser in 1902. Mr. J.E. Collin, who some years ago studied it again at my request, sent me the following notes, together with some sketches: ''*O. erythropsis* appears to be the same as *diomedeae* of your Table [*P. diomedeae* Coquillett, now considered a synonym of *aenescens*]. There is a specimen of *spinifera* in the [Bigot] collection (the type of *O. courtilleri* Fairm.). Compared with this, *erythropsis* is smaller, and, in addition to the differences mentioned by you, *erythropsis* has base of 2nd basal cell broader and more rounded, and apex squarer than in *spinifera;* in *spinifera* the upper outer angle of 2nd basal cell is acute owing to slope of cross-vein. The apical arms of fronto-clypeus [frons] in *erythropsis* are not quite so broad as in *spinifera*, but are turned outwards at tip and finely sculptured on inner margin very much as in *spinifera*. Palpi not very noticeably shorter. The postvertex is divided as in *spinifera*.'' I have now (1951) been able to see the type myself and to confirm Mr. Collin's findings. The specimen has a slight abnormality in the right wing, an additional cross-vein close to the tip of the first basal cell setting off a supernumerary small cell.

Original description of *P. diomedeae:* ''Head brown; a transversely-oval, elevated, polished, frontal spot reaching slightly below the middle of the front; a transverse parallelogrammatic one occupying the lowest median fourth of the front; orbits elevated and polished; remainder of the front depressed, opaque, gray pruinose; shorter hairs of antennae yellow, the stronger ones dark brown, changing into yellow at their apices; thorax polished brown, the angles yellow, the sides, transverse suture, a spot towards the middle of the thorax from each humerus and a second spot a short distance behind each of these, also two spots in front of the scutellum, opaque, gray pruinose; middle of sternum yellow; scutellum polished dark brown, destitute of bristles, posteriorly truncate and ciliate with very short hairs; abdomen dark brown, opaque, gray, pruinose; wings hyaline, veins brown, the first vein, except its base, usually yellow, last section of the fifth vein and the whole of the sixth except its base, whitish; apex of first vein noticeably before the small crossvein, apex of second vein about twice as far from the apex of the first vein as from tip of the third; legs brown, the lower side of the femora and the tibiae except their outer and inner edges, yellow; length 7 mm.'' Originally described from 4 specimens, it is now represented at U.S.N.M. by the ♂ holotype (No. 4431) and 2 ♂ paratypes. I have studied these several times, reaching the conclusion that they are cospecific with Bigot's *erythropsis* and Thomson's *aenescens*. The wing of the holotype is 7.5 mm. long; that of the two paratypes 8 mm. The third ♂ paratype is now at Stanford Univ., where I saw it in 1953.

Olfersia fumipennis (Sahlberg)

Figs. 83, 84*A*, 89*A–E*, 90*A–G*, 91 and 92

Lynchia fumipennis Sahlberg, 1884, Medd. Soc. Fauna Flora Fennica, **13**, p. 150 (♀ ♂. Finland: 4 ♂ and 2 ♀ cotypes, Thusby, on *Pandion h. haliaetus;* 2 ♂ cotypes, Kuopio. Cotypes ♀ ♂ at University Zoological Museum in Helsingfors and 1 ♂ cotype from Kuopio, at Mus.Comp.-Zoöl., Cambridge, Mass.).

Pseudolfersia fumipennis Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 165; 1907, Ent. News, **18**, p. 104 (synonymy of *Pseudolfersia maculata* Coquillet); 1908, Zeitschr. Wiss. Insektenbiol., **4**, pp. 244 and 303. Williston, 1908, Manual North American Diptera, 3rd Ed., p. 382, fig. 159 (after Washburn, 1905). Johnson, 1922, Psyche, **29**, p. 84 (New Jersey: Cape May and Lahaway, on *Pandion haliaetus caro-*

linensis. Florida: St. Augustine, on *Pandion haliaetus carolinensis*. Louisiana: Sand Point, on *Pandion haliaetus carolinensis*. New Hampshire: Hampton, on *Haliaeëtus l. leucocephalus*. Wisconsin: on *Gavia immer* [holotype of *P. maculata* Coquillett, 1899]. Cuba: on *Pandion haliaetus carolinensis*).

Olfersia fumipennis Johnson, 1925, Bull. Northeastern Bird-Banding Assoc., **1**, p. 52; 1925, Occ. Papers Boston Soc. Nat. Hist., **7**, p. 294. Johannsen, 1928, Cornell Univ., Agric. Expt. Sta., Mem. **101**, (for 1926), p. 868 (New York: Clove Valley near Poughkeepsie, on *Pandion haliaetus carolinensis;* Staten Island, on *Pandion haliaetus carolinensis*). Johnson, 1930, Publ. Nantucket M. Mitchell Assoc., **3**, pt. 2, p. 158 (listed for Nantucket, but not taken there). Winn and Beaulieu (revised by Petch and Maltais), 1932, Suppl. to 24th Rept. Quebec Soc. Prot. Plants, p. 90 (Quebec: St. Therese; Joliette). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 104. Spencer, 1938, Proc. Ent. Soc. British Columbia, No. **34**, p. 44 (in part: British Columbia: Kamloops; [not the records from Vancouver, which should be disregarded according to Prof. Spencer, *in litt.*]). Brimley, 1938, Insects North Carolina, p. 390 (North Carolina: Raleigh and Brunswick, on *Pandion haliaetus carolinensis*). J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 320 and 321; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 82. Guimarães, 1944, Papéis Avulsos Depto. Zool., São Paulo, **6**, No. 16, p. 183, figs. 1–2 (Brazil: Manacapurú, State Amazonas, on *Pandion haliaetus carolinensis*. Larva). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, p. 408, figs. 242–244 (Wisconsin: without precise locality, on *Gavia immer* [holotype of *P. maculata* Coquillett, 1899]. Michigan: Ann Arbor, on *Pandion haliaetus carolinensis*. Minnesota: Itasca Park, on *Pandion haliaetus carolinensis*). Webber, 1950, in Craighead, Insect Enemies Eastern Forests, (U. S. Dept. Agric. Misc. Publ. **657**), (1949), p. 529. Hennig, 1952, Larvenformen der Dipteren, **3**, p. 402. J. Bequaert, 1952, Verh. Naturf. Ges. Basel, **63**, No. 1, p. 219 (West Sumba, Indonesia: Rua, on *Pandion haliaetus cristatus*).

Pseudolfersia maculata Coquillett, 1899, Canad. Entom., **31**, p. 336 (no sex. Wisconsin: on *Gavia immer*, holotype. Also 8 paratypes without locality, on *Pandion haliaetus carolinensis*. Holotype ♀ from Wisconsin, at U.S.Nat.Mus., No. 4211; of the 8 paratypes, 7 [6 ♀, 1 ♂] also at U.S.Nat.Mus.). Johnson, 1900, 27th Rept. New Jersey Bd. Agric., (for 1899), p. 699 (New Jersey: Cape May and Lahaway, on *Pandion haliaetus carolinensis*). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Johnson, 1910, Ann. Rept. New Jersey State Mus., (for 1909), p. 814; 1913, Bull. Amer. Mus. Nat. Hist., **32**, p. 90 (Florida: St. Augustine, on *Pandion haliaetus carolinensis*). Lochhead, 1915, **7th** Rept. Quebec Soc. Prot. Plants, p. 130. Davis, 1922, Proc. Staten Island Inst. Arts Sci., **1**, p. 65 (New York: Staten Island, on *Pandion haliaetus carolinensis*). Bird, 1927, Jl. New York Ent. Soc., **35**, p. 102 (puparium).

Psuedolfersia maculata Washburn, 1905, 10th Ann. Rept. State Entom. Minnesota, (also as Agric. Expt. Sta., Minnesota, Bull. **93**), p. 159, fig. 155.

Pseudolfersia mycetifera Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 539 (♂. Arabia: Senafir or Sanafir I., in the northern Red Sea, 27° 56′ N., 34° 43′ E., on "Adler" [probably *Pandion haliaetus*]. Type in Vienna Mus.).

Olfersia fossulata Peters, 1936, Bird-Banding, **7**, p. 13 (Virginia: on *Pandion haliaetus carolinensis*). Not of Macquart, 1843.

Pseudolfersia sp. Brues and Melander, 1932, Bull. Mus. Comp. Zool., **73**, p. 346,

fig. 666 ("after Lugger," copied from Williston, 1908); 1954, *Op. cit.*, **108**, p. 385, fig. 666.

Distribution and Specimens Examined. Dominion of Canada. British Columbia (recorded by Spencer, 1938): Osoyoos Lake, 49° 2′ N., on *Pandion haliaetus carolinensis* (J. Poole); Kamloops, 50° 41′ N. (J. McT. Cowan and G.J. Spencer). — Quebec (recorded by Winn and Beaulieu, 1932; Lochhead, 1915): Joliette, 46° 3′ N., June, on *Pandion haliaetus carolinensis* (J. Ouellet).

United States. Arizona: Picacho Lake, Pinal Co., on *Pandion haliaetus carolinensis* (M.H. Frost, Jr.). — Florida (recorded by Johnson, 1913): without precise locality (C.J. Maynard); St. Augustine, Saint Johns Co., on *Pandion haliaetus carolinensis* (C.W. Johnson); Lake Flirt, on *Pandion haliaetus carolinensis* (R.H. Howe, Jr.). — Georgia: Savannah, Chatham Co., on *Pandion haliaetus carolinensis* (P.W. Fattig). — Kansas: Pratt Co., on *Pandion haliaetus carolinensis* (Bunker). — Louisiana (recorded by Johnson, 1922): South Point, Plaquemines Parish, on *Pandion haliaetus carolinensis*. — Massachusetts: Monomoy Point, Chatham, Barnstable Co., on *Pandion haliaetus carolinensis* (J.D. Smith); Chatham, Barnstable Co., on *Pandion haliaetus carolinensis*, April 24 (R.P. Dow); Fitchburg, Worcester Co., on *Pandion haliaetus carolinensis* (J.A. Peck). — Michigan (recorded by MacArthur, 1948): Ann Arbor, Washtenaw Co., on *Pandion haliaetus carolinensis*, April 22 (U.S.Nat.Mus.). — Minnesota (recorded by MacArthur, 1948): Itasca Park, Clearwater Co., on *Pandion haliaetus carolinensis*, May 15, (H.H. Knight and W.A. Riley). — New Hampshire (recorded by Johnson, 1922): Hampton, Rockingham Co., on *Haliaeëtus l. leucocephalus* (S.A. Shaw). — New Jersey (recorded by Johnson, 1900, 1922): Cape May, Cape May Co., on *Pandion haliaetus carolinensis* (H. Skinner; W. Stone); Lahaway near New Egypt, Ocean Co., on *Pandion haliaetus carolinensis* (J.T. Brakeley); Ramsey, Bergen Co., on *Pandion haliaetus carolinensis* (C.E. Sleight); Sandy Hook, Monmouth Co., on *Pandion haliaetus carolinensis* (T.D. Carter). — New York (recorded by Davis, 1922; Johannsen, 1928): Staten Island, on 2 *Pandion haliaetus carolinensis*, May 20 (J.P. Chapin) and Sept. 1 (W.T. Davis); Clove Valley near Poughkeepsie, Dutchess Co., on *Pandion haliaetus carolinensis*, May 2 (H. and J.B. Bird); Orient, Long Island, on *Haliaeëtus l. leucocephalus* and *Pandion haliaetus carolinensis* (R. Latham); Albany, on *Pandion haliaetus carolinensis*, Sept. 19. — North Carolina (recorded by

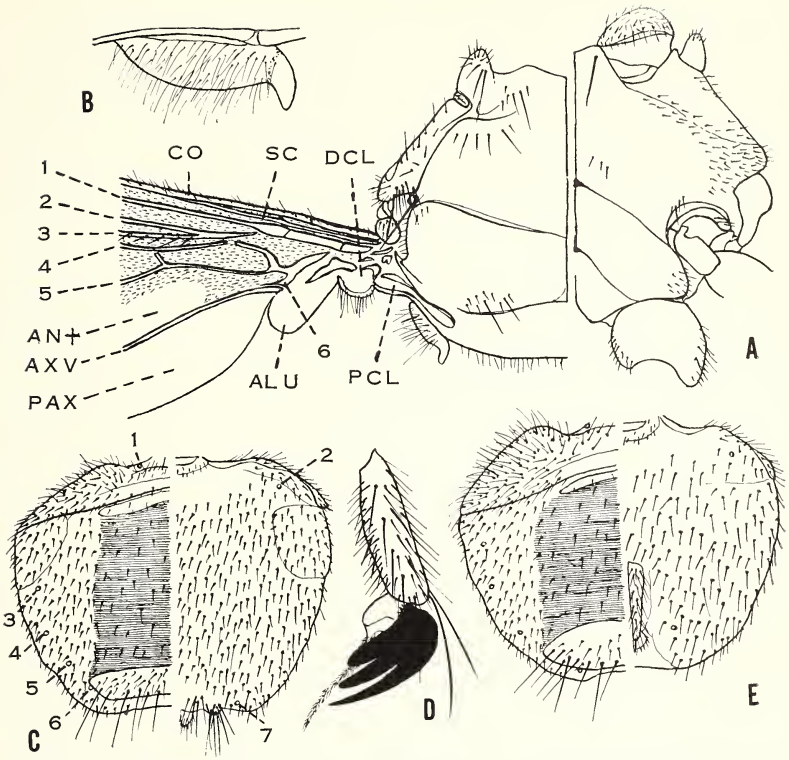

Fig. 89. *Olfersia fumipennis* (Sahlberg), ♀ and ♂, Huntsdale, Pa., on *Pandion haliaetus carolinensis:* **A**, thorax dorsally and ventrally, and basal area of left wing, ♀: *ALU*, alula; *AN+*, combined anal, 3rd posterior and axillary cells; *AXV*, axillary vein; *CO*, costa; *DCL*, upper calypter; *h*, humeral cross-vein; *PAX*, postaxillary cell; *PCL*, lower calypter; *SC*, subcosta; *1, 2, 3, 4, 5* and *6*, 1st, 2nd, 3rd, 4th, 5th and remaining stump of 6th longitudinal veins; **B**, left metanotal pleurotergite, ♀; **C**, abdomen dorsally and ventrally, ♀, the spiracles numbered 1 to 7; **D**, distitarsus and claw of hind leg, ♀; **E**, abdomen dorsally and ventrally, ♂.

Brimley, 1938): Four Oaks, Johnson Co., on *Haliaeëtus l. leucocephalus* (Mrs. R.C. Simpson); Raleigh, Wake Co., on *Pandion haliaetus carolinensis* (H.H. Hume); Winnabow, Brunswick Co., on *Pandion haliaetus carolinensis* (R.W. Leidy). — Ohio: Greenville, Darke Co., on *Pandion haliaetus carolinensis* (R. Rausch). — Oregon: Malheur National Wildlife Refuge, Burns, Harney Co., on *Pandion haliaetus carolinensis,* April 29 (G. Benson). — Pennsylvania: Philadelphia, in Zoological Garden, on *Pandion haliaetus carolinensis,* Oct. 1 (W. Huber); Reading, Berks Co., May 3, on *Pandion haliaetus carolinensis* (L.S. Dillon); Barree,

Huntingdon Co., on *Pandion haliaetus carolinensis* (C.W. Johnson); Huntsdale, Cumberland Co., on *Pandion haliaetus carolinensis* (B. Donley); Chester Co., on *Pandion haliaetus carolinensis* (R.M. Stabler). — TENNESSEE: Norris, Anderson Co., on *Pandion haliaetus carolinensis*, Sept. 14 (A.R. Cahn). — TEXAS: Valentine, Jeff Davis Co., on *Pandion haliaetus carolinensis* (P.A. Readio). — VERMONT: Windsor, Windsor Co., on *Coragyps a. atratus*, June 24 (J.D. Smith). — VIRGINIA (recorded by Peters, 1936): Onley, Accomac Co., on *Pandion haliaetus carolinensis* (H.S. Peters); Hog I., Accomac Co., on *Pandion haliaetus carolinensis* (C.L. Sperry); Virginia Beach, Princess Anne Co., on *Haliaeëtus l. leucocephalus*, Nov. 13. — WISCONSIN (recorded by Coquillett, 1899, as *P. maculata;* C.W. Johnson, 1922; MacArthur, 1948): without more definite locality, on *Gavia immer*, April 15, 1893; according to MacArthur (1948), possibly on the subsp. *elasson* (♀ holotype of *P. maculata* Coquillett).

MEXICO: San Benito Is., Baja California, on *Pandion haliaetus carolinensis* (G.P. Ashcraft).

BRITISH HONDURAS: without precise locality or host (Newham. — Received from P.A. Buxton); Turneffe Cay, on *Pandion haliaetus carolinensis* (S.M. Russell).

ANTILLES. BAHAMAS: Fish Cay, Crooked I., on *Pandion haliaetus ridgwayi* (H.S. Peters); W. Caicos I. (H.S. Peters). — CUBA (recorded by Johnson, 1922): without precise locality, on *Pandion haliaetus carolinensis* (J. Gundlach).

VENEZUELA: Puerto La Cruz, D.F., Caracas, on *Pandion haliaetus carolinensis* (E.G. Holt).

BRAZIL (recorded by Guimarães, 1944): Rio de Janeiro (A. Corrêa); Manacapurú, State Amazonas, on *Pandion haliaetus carolinensis* (C. Worontzow Daschkow).

O. fumipennis is nearly world-wide in distribution, occurring wherever its host, the osprey, is found, or at any rate, breeds. That it is better known from the New than from the Old World is due to the vagaries of collecting. In Europe, it was originally described from two localities in Finland; but I have also seen it from Walowiki, former Government Woronesch, USSR (W. Velitchkovsky. — Vienna Mus.). As *Pseudolfersia mycetifera* is a synonym, the Red Sea may be added to the range; moreover, I have seen a male from Kosseir, on the west coast of the Red Sea (Klunzinger. — Stuttgart Mus.). Specimens were taken from the Indonesian race of the osprey on Sumba (or Sandalwood) I. by the Buhler and Meyer Expedition. The northward extension of this fly on

both sides of the Atlantic is noteworthy. In Finland it reaches 62° 50′ N. and in North America about 50° 40′ N.

Known American Hosts of *O. fumipennis* (verified individual records in parentheses). Gaviiformes (1): *Gavia immer* (1). Falconiformes (46): *Coragyps a. atratus* (1); *Haliaeëtus l. leucocephalus* (4); *Pandion haliaetus carolinensis* (40); *P. haliaetus ridgwayi* (1).

In the Old World, *O. fumipennis* has only been taken on 2 races of *Pandion haliaetus.*

Bionomics. *O. fumipennis* uses the osprey or fishhawk, *Pandion haliaetus,* as a regular breeding host. This bird, the only representative of a distinct family of diurnal raptores, occurs in several races over much of the surface of the earth. J.L. Peters (1951) recognizes five geographical races and *O. fumipennis* has now been taken on four of these: in Europe on *P. h. haliaetus;* in North and South America on *P. h. carolinensis;* in the Bahamas on *P. h. ridgwayi;* and in Indonesia on *P. h. cristatus* (= *P. h. melvillensis*). This is one of the strictest cases of specificity known among the Hippoboscidae. Of 47 verified American host records, 41, or 87.2 per cent, are from osprey, 4 of the remaining being from American bald eagle, *Haliaeëtus leucocephalus,* one from a vulture, *Coragyps atratus,* and one from loon, *Gavia immer.*[61]

While the 4 records from bald eagle and the one from loon are clearly due to accidental straggling, there is a possible explanation for their occurrence. Mr. K. MacArthur (*in litt.*, 1956) called my attention to the following account of the habits of the bald eagle by T.S. Roberts (1932, *Birds of Minnesota,* **1**, p. 337), which, he suggests, might provide an answer to the problem. "It [the bald eagle] is by nature a robber and, unless forced by adverse conditions, will not put up a fair fight for its subsistence. The osprey, an excellent fisherman, and too small to defend itself against such a burley highwayman, is the special object of its nefarious attacks. Both birds locate their nests near large bodies of water. While the osprey is patrolling the lake looking for food, the eagle sails high overhead watching proceedings. When the osprey plunges, the eagle is all attention and, as soon as the captured fish has been carried some distance above the water, swoops

[61] Professor G.J. Spencer informs me that the two records of *O. fumipennis* from *Melospiza lincolnii gracilis* and *Vermivora celata lutescens,* at Vancouver, which he published in 1938, should be disregarded. The host labels must have been written by error.

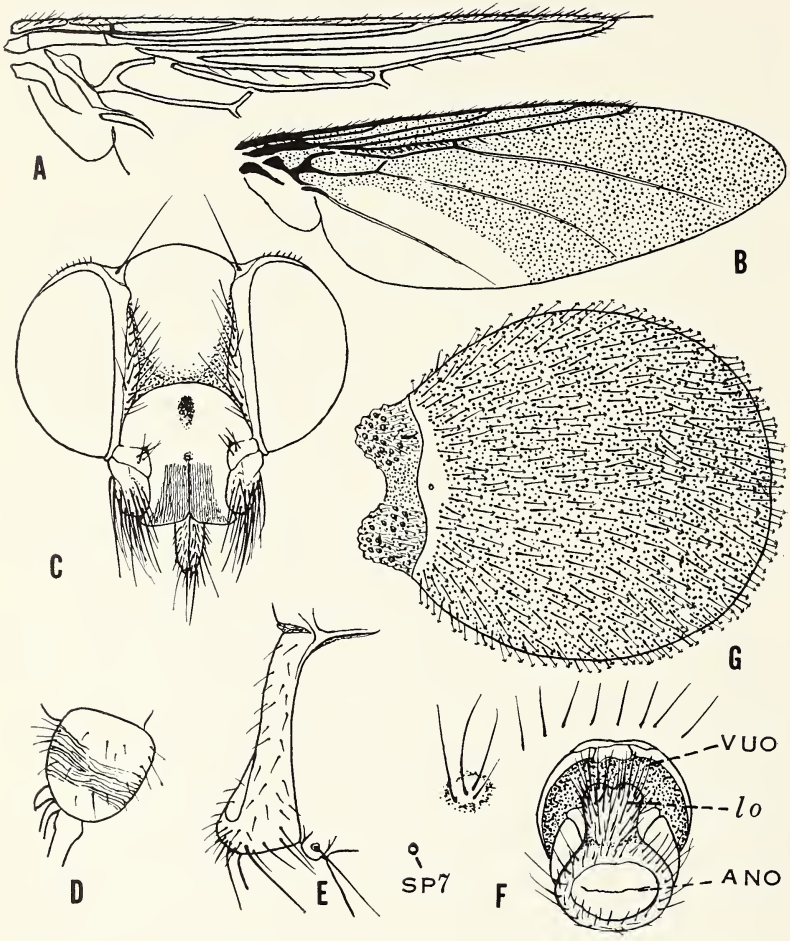

Fig. 90. *Olfersia fumipennis* (Sahlberg), ♀, Huntsdale, Pa., on *Pandion haliaetus carolinensis:* **A**, anterior part of wing, the microtrichia omitted; **B**, wing; **C**, head; **D**, tegula; **E**, dorsal aspect of left anepisternum; **F**, ventral ano-genital area, drawn from fly in alcohol: *ANO*, anal opening; *lo*, fused lobes on rim of anal sclerite; *SP7*, 7th abdominal spiracle; *VUO*, vulvar opening; **G**, puparium.

down on the smaller and heavily laden bird, the assault forcing the release of the fish, which by a quick dash the eagle seizes in its claws before it reaches the water. The osprey is left to make another hunt, which may end the same way. During a winter spent by the writer along the east coast of Florida, where both ospreys and eagles were common, this robbing of the ospreys was a daily, sometimes an hourly sight. . . . At Lake Itasca [Minnesota], where there are aeries of both species, this merciless plundering can be witnessed daily. One morning an eagle was seen to rob an osprey of three of its five catches, the other two being saved while the bandit was busily feeding its young with its ill-gotten quarry.'' In his letter Mr. MacArthur offers the following comments on this article: ''In diving onto the osprey to force the dropping of his catch, there are undoubtedly times when the bodies of the two birds are, momentarily at least, in direct contact, and it is not difficult to understand how an actual transfer of an occasional louse-fly, from osprey to eagle could occur. Likewise, although mating pairs of both osprey and bald eagle are known to utilize their respective nesting sites, ordinarily year after year, adding to them until they become quite cumbersome affairs, nevertheless, according to Roberts (*Op. cit.*, p. 349), sometimes the ospreys in a certain area may be subject to such continual thievery on the part of the bald eagle as to make it difficult or impossible for the osprey to maintain itself. If the osprey abandons such areas, the bald eagle might in some instances take over the deserted nesting sites, either an exceptionally tall tree or a rocky prominence, as a point of vantage for resting and observation because it offers the only commanding view of the surrounding country. Under such circumstances individuals of *Olfersia fumipennis*, newly emerged from abandoned nest debris of the osprey, would have no alternative but to seek temporary refuge on the body of the new tenant. Similarly with respect to the straggling of *O. fumipennis* on loon, it is conceivable that the osprey could, without too much difficulty, unwittingly disengage some of its flies during its frequent swift plunges into the water, particularly if flies chance to be on the feather surface at the moment of impact. If this were to occur, an osprey louse-fly would clamber onto the body of any swimming bird that happened to be in the vicinity, where it would be isolated from the normal host and either have to adapt itself temporarily to the new host or perish. From my own observations in the Great Lakes area, loons and ospreys are frequently the only aquatic bird life in evidence on the more northern lakes.'' Another ecological fac-

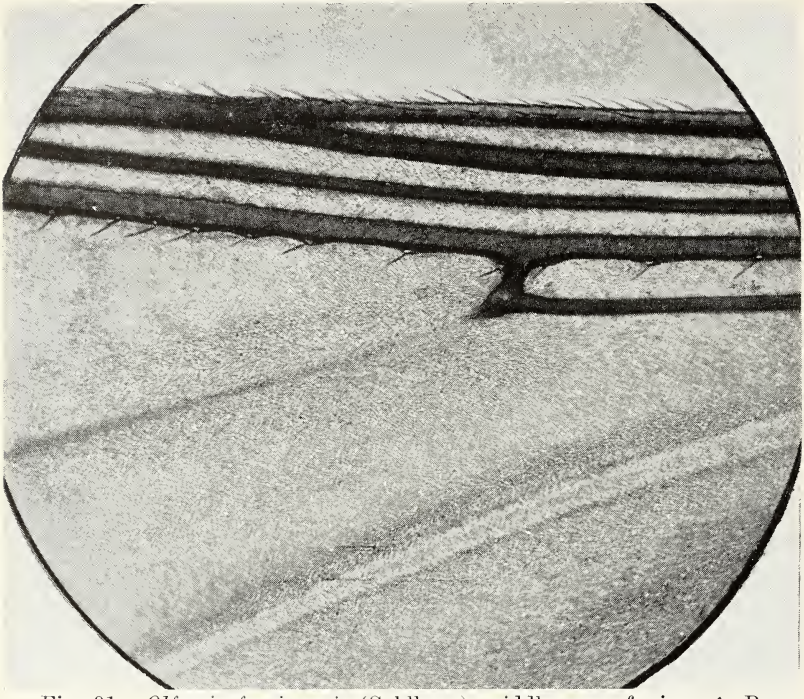

Fig. 91. *Olfersia fumipennis* (Sahlberg), middle area of wing, ♂, Burns, Oregon, on *Pandion haliaetus carolinensis*. Photograph by Mr. K. MacArthur (1948, fig. 242).

tor possibly to be considered is that osprey, bald eagle and loon nest in a similar environment close to permanent open water. Bald eagle and osprey, moreover, sometimes nest close to each other and both build nests of the same type some distance above ground, preferably in trees.

In Part I I have given some information on infestation with fungi of the order Laboulbeniales (p. 141) and with mites (p. 160), as well as on the host relations (p. 316). A second case of mite infestation concerns a ♀ from Norris, Nebr., on *Pandion haliaetus carolinensis*, with a ♀ mite without eggs attached to the left side of the abdomen, near the tip.

Guimarães (1944) figures a newly voided, presumably full-grown larva, obtained from a fly taken at Manacapurú on *Pandion haliaetus carolinensis*. This he describes as follows (translated from the Portuguese): "It is oval in shape, like the previously known larvae, about 4.5 to 5 mm. long and 3.5 mm. wide. Posteri-

Fig. 92. *Olfersia fumipennis* (Sahlberg), ♂ terminalia, extended, Burns, Oregon, on *Pandion haliaetus carolinensis*. Photograph by Mr. K. MacArthur (1948, fig. 244).

orly the body ends in a single stigmatic cap, darkly pigmented, with the 2 polypneustic lobes, on each side with 50 to 60 pores. The pores are placed on slight cuneiform elevations surrounded by minuscule depressions. Between the 2 polypneustic lobes lies a deep transverse excavation, simulating an opening and with a small elevation in the center; the stigmatic cap is finely granulose above and below this excavation. On the ventral side of the larva, close to the stigmatic cap, the middle line shows a small opening surrounded by a darkly pigmented ring, which should be the anal opening. . . . At the opposite end lies the mouth, as previously recognized by Pratt in *Melophagus ovinus*, on a small elevation with a projection on each side. Except over the stigmatic cap and over a ring-like anterior zone, the larva is covered with very typical spines, but their tips are anchor-shaped. Between the spines, the cuticle of the larva shows small circles. In the spine-free, ring-like zone the suture along which the puparium will break open to release the adult, is partially visible. Likewise, a transverse, very conspicuous line, running close to the mouth, may be traced, dividing the operculum into halves.'' I have seen 2 puparia deposited by flies from Chester Co., Pa., on *Pandion haliaetus*

carolinensis, which agree perfectly with Guimarães' account and his measurements (Fig. 90*G*). The late Henry Bird, of Rye, N.Y., was the first to obtain a puparium of this species from a fly taken on *Pandion haliaetus carolinensis*, near Poughkeepsie, N.Y. He exhibited the fly and its offspring on December 1, 1925, at a meeting of the New York Entomological Society, calling attention particularly to the "anchor-like setal hooks" covering the puparium. This appears from 2 letters which he wrote me at that time (Nov. 30, 1925, and Feb. 5, 1926). In one of these he stated that his talk before the Society had to do "with the evagination of a puparium so nearly the size of the mother, and the setal hooks thereof, which upon my assumption are for anchoring it among the feathers of the host, rather than for the possibility of its being placed in the nest." Although the talk elicited some comments from those present, the published minutes of the meeting (1927, Jl. New York Ent. Soc., **35**, p. 102) unfortunately omit these interesting details.

Affinities. As will be discussed in detail for *O. bisulcata*, that species forms a compact group of close allies with *O. fumipennis* and *O. fossulata*. Few reliable diagnostic characters can be added to those given in the key. The 2nd basal cell is relatively long, more than half the length of the 1st basal cell, in *O. fumipennis*. The setae on the 3rd longitudinal vein are better developed than in the other two species and occur as a rule over the entire length of the vein, although some of them may be lost occasionally in old flies. In all 3 species the 1st antennal segment is divided from the basal area of the frons by an incomplete suture, interrupted medially; the inner, deeper section of this suture sends off a short, superficial, oblique branch, the remnant of the transverse suture which in most Hippoboscidae separates the lunula from the frons proper. In *O. fumipennis* (Fig. 84*A*) this rudimentary suture is somewhat better defined than in its two allies.

Original description of *L. fumipennis:* "Nigro-aenea, nitida, thoracis maculis nonnullis pruinosis ventreque opacis, cinereis, pulvillis unguiculorum pallide flavis, fronte maculis duabus triangularibus piceo-rufis, vertice nitidissimo; hypostomate medio bifoveolato; alis magnis, fumatis, limbo angustissimo apicali et interiore pallidiore, basi punctis et lineolis hyalinis. Long. 4 lin. [= 8.7 mm.]. — *Mas:* segmento ultimo ventrali apice late emarginato, appendicibus duabus cylindricis pilosis armato; valvulis genitalibus corneis, a basi latiore subito angustatis, deinde linearibus acuminatis, retrorsum curvatis. — *Femina:* abdomine lateribus utrinque lobato, apice emarginato, segmento ultimo ventrali basi crista transversali fere semicirculari munito, apice appendice parva squamiformi armato. — Species magna, nigra, metallice splendens, pedibus concoloribus, alis nigrofumatis inter alias Hippoboscidas in avibus hospitantibus insignis. — Caput porrectum, deplanatum, nigro-aeneum,

politum; clypeo apice leviter emarginato, supra antice longitudinaliter dense striato, linea media distincta, postice foveis duabus, posteriore majore instructo, basi linea profunda arcuato terminato; fronte utrinque ad oculis plaga triangulari submembranacea, intus callo lineari terminata, piceo-rufa; temporibus angustis, holosericeis, seta valida armatis; ocellis nullis. Antennae in fovea frontali juxta oculos suboccultae, squamiformes, nigro-aeneae, multisetosae. Palpi exarticulati valvuliformes, obtusiusculi, pilosi, vaginae instar haustellum amplectantes. Haustellum filiforme absque proboscide terminali, nigrum. Oculi magni, piceo-nigri. Thorax capite plus duplo latior, aeneo-niger, nitidus, maculis parvis cinerascentibus opacis lateralibus variegatus; sulco transversali medio interrupto satis distincto; supra subtiliter strigulosopunctatus, medio linea lata subelevata laevi, antice et postice setis nonnullis nigris munitus; lateribus pone angulos anticos callosos acute incisis. Stigma in ipsa incisura positum, transversim lineare. Scutellum transversum, apice truncatum, fulvo-ciliatum, nigro-aeneum, nitidum, sublaeve. Metanotum angulis posticis appendiculo parvo pallido munitis. Abdomen in mare transversim rotundatum, in femina paullo longius, utrinque ante medium obtuse sublobatoproductum in utroque sexu nigrum, pubescens, supra setis nonnullis nigris munitum. Alae subcoriaceae, abdomine plus quam duplo longiores, quam in *Hippobosca* distincte angustiores, apice obtuse rotundatae; nigro-fumatae, venis nigricantibus; costali longe pone medium extensa, breviter ciliata; vena mediastina tenui cum costali paullo ante ejus medium confluente; subcostali acute elevata, recta, paullo pone initium partis tertiae ultimae venae costalis incurrente; area costali valde angusta, antice ad initium venae mediastinae venula obsoleta transversali divisa; vena prima longitudinali e subcostali egrediente, mox pone basin puncto hyalino interrupta, deinde in ramis duobus fere parallelis rectis furcata, ramo anteriore seu radiali paullo ante, posteriore seu cubito in ipso apice costae incurrente; vena secunda longitudinali seu brachiali basi incrassata, deinde anguste interrupta, et sigmoidea-flexa, dein bifurcata, ramis valde divaricatis, anteriore basi versus marginem anticum directo, deinde valde curvato et juxta furcam cubiti puncto albido-hyalino interrupto, subrecto, pone apicem alae in margine postico incurrente, ramo posteriore leviter curvata, prope medium marginis posticis alae in margine incurrente; vena transversali ordinaria brevi, perpendiculari; area discoidali basi obtuse rotundata, postice vena obliqua transversali subinterrupta terminata; vena transversali posteriore nulla; vena anali e radicibus duabus orta, prima e basi brachii excurrente, secunda e basi alae egrediente, anguste interrupta; praeterea in alis venis tribus spuriis seu plicis observandis, prima ante venam analem, secunda et tertia prope basin alae, subparallelis, loco venae axillaris; lobo basali brevi, incisura acuta terminato; limbo toto alae ab apice costae valde angusto magis hyalino. Squamae sub alis brevissimae, rudimentariae, pallidae. Halteres sub angulo postico metanoti occulti, albido-flavi. Pedes validi, aeneo-nigri, antici magis quam postici a mediis remoti, pallidopubescentes et nigro-pilosi; coxis antice apice longe nigro-ciliatis, tibiis omnibus extus carinatis; tarsorum articulis tribus intermediis brevissimis, posticorum articulo basali insequentibus tribus simul sumtis longiore; unguiculis nigris, validis, curvatis, apice acute tridentatis, dente interiore pallidiore; pulvillis duobus squamiformibus, pallide flavis; empodio filiformi nigro. Abdomen nigrum, opacum, fusco pubescens, ventre pallidiore, suturis segmentorum obsoletis, dorso magis nitido, basi transversim carinato-elevato." The type specimens are now in the University Zoological Museum in Helsingfors (Helsinki). Through the kindness of Dr. Richard Frey, I was able to study two male cotypes from Kuopio and Thusby, showing no appreciable difference from the American flies taken on osprey. The male from Kuopio was presented by Dr. Frey to the Mus. of Comp. Zool.; its wings are 8.8 mm. long.

Original description of *P. maculata:* "Front [mediovertex] yellowish-brown, the polished lateral margins and vertical triangle dark brown, the latter tapering anteriorly, broadly rounded at the tip, almost reaching the lower end

of the front, a black bristle each side of the vertex and a row of smaller yellow ones on each side of the lower two-thirds of the front inside of the polished lateral margins; clypeus [frons] brown, yellowish medially, polished, noticeably longer than broad, notched in the middle of the apex and sulcate in the middle, the sulcus terminating in a deep fovea near the base of the clypeus; antennae brown, subovate but flattened above, lying in deep grooves, not reaching apex of the clypeus [frons], polished except the inner portion of its upper side which is opaque gray pruinose, bearing toward its apex a few yellow hairs and many long black bristles; palpi brown, projecting slightly more than their greatest width beyond the apex of the clypeus; under side of the head brown, a yellow median longitudinal sulcus, and a rather large white lobe at its anterior end. Thorax dark brown, polished, the humeral tubercles apically yellow, a spot at inner side of each, another a short distance back of it, a stripe reaching from the prothoracic stigmata to base of wing, the transverse suture and a pair of spots on the posterior end of the thorax opaque gray pruinose, no median longitudinal sulcus, the transverse sulcus interrupted in the middle; pleura thinly gray pruinose except three spots along the suture in front of wings, sternum polished except its extreme anterior end which is gray pruinose; scutellum polished brown, truncate posteriorly, bare except a short pubescence along the posterior margin. Abdomen opaque grayish brown, the apex and venter yellow. Wings smoky brown, apex of auxiliary vein [subcosta] slightly beyond apex of second basal cell, that of first vein slightly beyond apex of first basal cell, of the second vein nearly midway between the apices of the first and third veins; first two sections of fourth vein subequal in length. Legs polished brown, front coxae anteriorly opaque gray pruinose, pulvilli yellow, basal tooth of each tarsal claw yellowish. Length 7 to 8 mm.'' I have examined the ♀ holotype and 7 paratypes (6 ♀ and 1 ♂) several times at the U.S.Nat.Mus. I could find no character to separate them from the European type of *O. fumipennis* and I consider them cospecific. The wing of the holotype is 8 mm. long.

Original description of *Pseudolfersia mycetifera* (translated from the German): ''Length, 7.5 mm.; from anterior margin of mouth to hind margin of scutellum, 4 mm. The species differs from all others in the genus in the pale color, being uniformly brownish-yellow, with paler legs and grayish-brown abdomen. The head is shaped exactly as in *P. aenescens* Thomson; the antennal appendages are not darker than the remainder of the head; the clypeus [frons] has a narrow dark-brown margin. The humeral callosities are pointed, directed straight forward and a little paler than the surface of the thorax, but the scutellum concolorous with the thorax. The legs and ventral side are paler brownish-yellow; only the terminal segments of the tarsi and the hind metatarsi darker. The wings are very slightly brownish, with russet-brown veins; second basal cell nearly half as long as the first; second basal cross-vein (''hintere Querader'') slightly oblique. Abdomen with the narrow [short] basal segment brownish-yellow, hardened and sclerotized; integument elsewhere soft, grayish-brown, also at the anal and genital openings, without harder sclerotized areas.'' Speiser also noted on the abdomen of the type clusters of fungi which he referred correctly to Laboulbeniales. Through the courtesy of the authorities of the Vienna Museum and the kind assistance of Dr. Fred Keiser, of Basel, I have recently been privileged to examine the male holotype, preserved in alcohol. The wing is nearly 9 mm. long. I could find no structural character separating it from specimens of *Olfersia fumipennis*, from ospreys. It should be pointed out particularly that the head is not shaped as in *O. aenescens*, which has much enlarged upper orbits, the combined vertex and mediovertex divided by a curved, transverse depression, a wide interocular face and differently shaped apical lobes of the frons (Fig. 85*C*). None of these features are present in the type of *mycetifera*, which agrees instead with *O. fumipennis* (Fig. 90*C*). Most of the *O. fumipennis* I have seen are almost completely fuscous-black, usually with a few, small paler brown areas; some specimens, however, are more ex-

tensively mahogany-brown and a few from North American ospreys are scarcely darker on head, thorax and legs than the type of *mycetifera*. As shown in Part I (p. 139), Speiser was correct in interpreting as Laboulbeniales the peculiar fungous growths he noticed on the type of his *mycetifera*.

Olfersia bisulcata Macquart

Figs. 86*A–B* and 93*A–I*

Olfersia bisulcata Macquart, 1847, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1846), p. 111; Pl. 6, fig. 12 [1847, Dipt. Exot., Suppl. **2**, p. 95; Pl. 6, fig. 12] (no sex; no host. Chile. Type ♀ from Bigot Coll., now in J.E. Collin Coll.). J. Bequaert, 1933, Psyche, **40**, pp. 102 and 104; 1933, Rev. Chilena Hist. Nat., **37**, p. 164; 1938, Carnegie Publ. No. **499**, p. 227. Martorell, 1939, Jl. Agric. Univ. Puerto Rico, **23**, p. 221. J. Bequaert, 1940, Rev. Acad. Colombiana Ciene. Ex. Fis. Nat., **3**, No. 12, p. 416; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 81. Cooper, 1942, Amer. Philos. Soc. Yearbook for 1941, p. 125 (Panama: on "*Catharista urubu*" [=*Coragyps a. atratus*]. Chromosomes); 1944, Genetics, **29**, p. 538 (Panama: Orchid I. in Gatun Lake, on "*Catharista urubu*" [=*Coragyps a. atratus*]. Chromosomes). Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. de Buen, 1950, An. Inst. Biologia, México, **21**, pt. 2, p. 416 (México: Sa. Rosa, Comitán, State Chiapas, on *Sarcoramphus papa*). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (for 1950), p. 9. Makino, 1951, Atlas of Chromosome Numbers in Animals, p. 212. White, 1954, Animal Cytology Evolution, 2nd Ed., p. 223.

Pseudolfersia bisulcata Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 179 (type); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 189 and 195 (copy of description).

Olfersia vulturis van der Wulp, 1903 Biol. Centr.-Amer., Diptera, **2**, p. 429; Pl. 13, figs. 1-1*a* (types doubtfully given as ♀. Costa Rica: Río Sucio, on vulture. Cotypes ♀ ♂ at Brit.Mus.). J. Bequaert, 1926, Medical Rept. Hamilton Rice 7th Exped. Amazon (1924–25), p. 240. Ferris, 1928, Ent. News, **39**, p. 36, figs. *A–B* (Mexico: San Blas, State Nayarit, on "*Catharista urubu*" [=*Coragyps a. atratus*]. Larva). J. Bequaert, 1932, Psyche, **38**, (for 1931), pt. 4, p. 190; 1933, Carnegie Publ. No. **431**, p. 570. Dunn, 1934, Psyche, **41**, p. 175 (Panama: Camp Pital, Chiriqui Prov., on "*Catharista urubu*" [=*Coragyps a. atratus*]).

Pseudolfersia vulturis Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 264 (types ♀ ♂). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 179; Pl. 27, fig. 4; Pl. 28, fig. 2 (Brazil: State Goyaz; Rio de Janeiro. On *Cathartes urubutinga*, "*Catharista atratus* var. *brasiliensis*" [=*Coragyps atratus foetens*], *Cathartes* "*aura*" [=*C. aura ruficollis*], and *Gypagus papa*" [=*Sarcoramphus papa*]). Murphy, 1921, Comp. Administr. Guano, **12**a Mem. del Directorio, Lima, p. 113 (Peru: Central Chincha I., on *Cathartes aura* [*jota*]; 1925, Bird Islands of Peru, p. 250. Ad. Lutz and Nuñes-Továr, 1928, Estudios Zoología Parasitología Venezolanas, p. 9 (Venezuela: on 2 species of vultures). Carbonell, 1938, Parasitología en Venezuela y los Trabajos del Dr. M. Nuñez-Továr, p. 251. Schuurmans Stek-

hoven, 1952, Beiträge zur Fauna Perus, **3**, Wissensch. Bearbeit., pp. 92 and 101 (Peru: Hacienda Huayuri, on vulture).

Pseudoolfersia vulturis Vogelsang, 1936, Rev. de la Policlinica, Caracas, **6**, No. 31, p. 2.123 (Venezuela: Maracay, on "*Cathartes urubu*" [= *Coragyps atratus foetens*]).

Pseudolfersia vulturus Bodkin, 1919, Brit. Guiana Dept. Sci. Agric., Rept. for 1917, p. 62 (British Guiana: N.W. District, on "*Catharista urubu*" [= *Coragyps atratus foetens*]). Cleare, 1919, Brit. Guiana Med. Annual for 1919, 22nd Year, Demerara, p. 70 (same record).

Pseudolfersia mexicana Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 179 (Mexico: specimen labelled "*mexicana*" from Bigot Coll., now in J.E. Collin Coll; [this is not Macquart's type]); 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304. Not *Olfersia mexicana* Macquart, 1843, which is *Lynchia nigra* (Perty).

Pseudolfersia (*Feronia*) *spinifera* Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (in part: only specimen from Pará, Brazil, on "*Catharista urubu*" [= *Coragyps atratus foetens*]). Not *Feronia spinifera* Leach, 1817.

Olfersia spinifera Dunn, 1934, Psyche, **41**, p. 175 (Panama: Camp La Vaca, Chiriqui Prov., on *Sarcoramphus papa*). Not of Leach, 1817.

Olfersia sp. Darling, 1912, Bull. Soc. Path. Exot., Paris, 5, p. 71 (Panama: Ancon, on *Cathartes a. aura*).

Olfersia diomedeae Falcoz, 1930, Encyclop. Entom., Sér. B, Diptera, **5**, (for 1929), p. 46 (in part: only specimens from Venezuela: Lower Sarare). Not of Coquillett, 1901.

Distribution and Specimens Examined. United States. Louisiana: New Orleans, ♂ in a plane arriving from Balboa, Panama, Feb. 19, 1949 (U.S.Publ.H.Serv., through Dr. J.H. Hughes). — Texas: Edinburg, Hidalgo Co., 26° 20′ N. (S. and D. Mulaik); Uvalde Co., 29° 15′ N., on *Coragyps a. atratus*, Oct. 13, 1933 (A.W. Lindquist); Brownsville, Cameron Co., ♂ in a plane arriving from Mexico, June 8, 1947.

Mexico (recorded by Speiser, 1902; Ferris, 1928; de Buen, 1950): without precise locality, on vultures, probably *Coragyps a. atratus* (Esc.N.C.Biol.); San Blas, State Nayarit, on *Coragyps a. atratus* (G.F. Ferris); Iguala, State Guerrero, on vulture (Esc.-N.C.Biol.); Hato Frontera, State Chiapas, on *Sarcoramphus papa* (Esc.N.C.Biol.); Santa Rosa, Comitán, State Chiapas, on *Sarcoramphus papa* (Esc.N.C.Biol.); Tuxtepec, State Oaxaca (J. Camelo G.); Chitzen Itzá, State Yucatan, on *Coragyps a. atratus* (J. Bequaert); Xocempich, 10 miles from Chichen Itzá, State Yucatan, on *Coragyps a. atratus* (D.B. Legters); Mexico, D.F., on human (F. Biagi F.).

British Honduras: Belize, on *Sarcoramphus papa* (J.P. Johnson).

Guatemala: Concepcion del Mar, Dept. Escuintla, on *Coragyps a. atratus* (E.R. Blake); Guatemala City (Dr. Morales).

Nicaragua: Waunta-Hannover (W.H. Fluck).

Costa Rica (recorded by van der Wulp, 1903, as *O. vulturis*):

Río Sucio (Rogers. — ♀ and ♂ cotypes of *O. vulturis* at Brit. Mus.); Turrialba, on *Cathartes a. aura* (K.W. Cooper).

Panama (recorded by Darling, 1912, as *Olfersia* sp.; Dunn, 1934, as *vulturis* and *spinifera;* Cooper, 1942, 1944): Orchid I., Gatun Lake, C.Z., on *Coragyps a. atratus* (K.W. Cooper); Río Trinidad, on *Cathartes a. aura* (A. Busck); Camp Pital, Chiriqui Prov., on *Coragyps a. atratus* (L.H. Dunn); Ancon, C. Z., on *Coragyps a. atratus* (L.H. Dunn); Panama City, on *Coragyps a. atratus* (L.H. Dunn); Tapia, C. Z., on *Sarcoramphus papa* (J.P. Chapin); Camp La Vaca, Chiriqui Prov., on *Sarcoramphus papa* (L.H. Dunn); San-José, Pearl Is., on *Cathartes a. aura* and coming to light (J.P.E. Morrison); Porto-Bello, on *Cathartes a. aura* (A. Busck).

Colombia: Villavicencio, Int. del Meta, on *Coragyps atratus foetens* (E. Osorno-Salcedo; R.M. Gilmore); Meta District, on *Sarcoramphus papa* (B. Guevara); Victoria, Dept. Caldas, on *Cathartes aura jota* (E. Osorno-Salcedo).

Venezuela (recorded by Lutz and Nuñes-Továr, 1928; Falcoz, 1930, as *diomedeae;* Vogelsang, 1936, as *P. vulturis*): Puerto La Cruz, D.F., on *Coragyps atratus foetens* (E.G. Holt); Selvas de San Camilo, States Tachira and Barinas (P. Anduze); San Esteban, State Carabobo, on *Coragyps atratus foetens* (P. Anduze); southeastern Guarico, on *Vultur gryphus* (P. Anduze); Caura Valley.

Trinidad: Quare Dam, on *Sarcoramphus papa* (A.M. Adamson).

British Guiana (recorded by Bodkin, 1919): Issororo, on *Coragyps atratus foetens* (C.E. Bodkin); Georgetown, on *Cathartes aura ruficollis* (W. Beebe); Kartabo (W. Beebe); Kalacoon (W. Beebe).

French Guiana: without host or precise locality (H. Floch).

Brazil (recorded by Austen, 1903, as *spinifera;* Lutz, Neiva and da Costa Lima, 1915): Cayari I., Uassa Swamp, State Pará on *Sarcoramphus papa* (S.M. Klages); Manáos, State Amazonas, on *Coragyps atratus foetens* (J. Bequaert); Vista Alegre, Rio Branco, State Amazonas, on *Coragyps atratus foetens* (J. Bequaert); Pará; Rio de Janeiro, in Zoological Garden, on *Vultur gryphus* (Ad. Lutz); State Minas Gerais, on *Cathartes aura ruficollis* (Ad. Lutz); Maracajú, State Matto Grosso, on *Cathartes aura ruficollis* (R.M. Gilmore); Aguafria, State Matto Grosso, on *Coragyps atratus foetens* (G. Fairchild); São-José-dos-Campos, State São Paulo, 23° 10′ S., on *Coragyps atratus foetens* (H. de Souza Lopes);

Cana Brava, State Goyaz (J. Blaser); State Goyaz, on *Sarcoramphus papa* (A. Neiva); Joazeiro, State Piauhy, on *Cathartes aura ruficollis* (A. Neiva); Fazenda Sto Amaro, Volta Grande, State Minas Gerais, on *Cathartes aura ruficollis* (C. Lako); Floresta da Capela de S. Braz, Sta. Teresa, State Espirito Santo, on *Cathartes aura ruficollis* (C. Lako); Rio Tapajos, State Pará, on *Coragyps atratus foetens;* State São Paulo, on *Sarcoramphus papa;* Porto Alegre, State Minas Gerais (F.S. Pereira); Goiania, State Goyaz, on *Cathartes aura ruficollis* (E. Dente).

Bolivia: Province Sara (J. Steinbach).

Peru (recorded by Murphy, 1912; Schuurmans Stekhoven, 1952): Central Chincha I., on *Cathartes aura jota* (R.C. Murphy); Trujillo, on vulture (W. Weyrauch); Negritos (N.Y. State Mus.).

Chile (recorded by Macquart, 1847): without precise locality, ♀ type of *bisulcata.*

O. bisulcata is restricted to the New World, where it is essentially a tropical insect. The only two captures under natural conditions in the United States are from extreme southeastern Texas and they may have been accidental occurrences. The northmost record is from 29° 15′ N. and the southmost from 23° 10′ S.

Known hosts of *O. bisulcata* (verified individual records in parentheses). Falconiformes (44 and 3 unidentified vultures): *Cathartes a. aura* (4); *C. aura jota* (2); *C. aura ruficollis* (7); *C. urubutinga; Coragyps a. atratus* (10); *C. atratus foetens* (9); *Sarcoramphus papa* (10); *Vultur gryphus* (2).

Bionomics. To judge from the list of known hosts, *O. bisulcata* is a strictly specific parasite of vultures and condors (Family Cathartidae).[62] Although these birds are included in the Order Falconiformes, they are very distinct and perhaps not closely related to the other diurnal birds of prey. The fact that they possess a peculiar fly, of a genus not found normally on other Falconiformes, may have some significance in this connection. The fly seems to be about equally frequent on the three common American vultures: the turkey vulture (*Cathartes aura*), the black vulture (*Coragyps atratus*) and the king vulture (*Sarcoramphus papa*). The records from urubitinga (*Cathartes urubutinga*) and condor (*Vultur gryphus*) are as yet too few to decide whether or not these birds are true breeding or only accidental hosts.

The following note by C.B. Koford (1953, The California

[62] A published record from "sparrow hawk" (J. Bequaert 1933*a,* p. 570) should be discarded as unreliable.

Condor, p. 125) suggests that *Gymnogyps californianus* occasionally harbors either *O. bisulcata* or *Lynchia nigra:* "Twice I saw a flat-bodied fly, probably a hippoboscid, on the head of a nestling." If confirmed, this occurrence will add one of the two flies to the California list.

O. bisulcata is a common hippoboscid. In many localities it occurs on nearly every vulture examined and often in some numbers on one bird. Ferris (1928*a*), for instance, took 16 specimens in Mexico from one black vulture and estimated that the bird had harbored 30 to 40 flies. Dr. J.P. Chapin informs me that some 12 to 15 flies escaped from a freshly killed king vulture, in Panama, after the bird was brought indoors.

The newly deposited third larval instar, 5 mm. long when flattened and mounted on a slide, was described and figured by Ferris (1928*a*) as follows. "The posterior end is capped by a single plate, representing probably a fusion of the usual paired spiracles, this plate being pierced by a number of small, pore-like openings which communicate with tracheal trunks." The arrangement of the pores could not be determined. "The entire body, excepting only the stigmatic plate and a narrow transverse zone which extends entirely about the body near the cephalic end, is thickly beset with short spines. These are spines, not setae, there being no socket. They vary somewhat in size, being noticeably larger near the center of the body on both dorsal and ventral sides. In addition to these the derm is everywhere marked by small, subcircular, clear areas. The transverse zone which is free from spines marks the line along which the puparium splits at the time of emergence of the adult." Three puparia I have seen from Uvalde, Texas, obtained from adults on *Coragyps a. atratus,* agree with this description, except, of course, that the integument is completely hardened and black throughout. The stiff, prickly hairs are thin, pointed, straight (Fig. 93*G*), either somewhat slanting or erect on the puparium; on the intrauterine and newly-voided larva they lie flat, with the points directed forward. A careful examination has failed to disclose the anchor-shaped barbs at the tips of the hairs found in the other 4 species of *Olfersia* with known puparia. The puparium (Figs. 93*F–I*) is 4 to 4.5 mm. long, 3 mm. wide and 2.5 mm. thick, regularly and broadly ovoid seen from above, more elliptical in side view. The two polypneustic lobes are separated by a broad, shallow saddle; each lobe bears about 50 minute respiratory pores on irregular, fairly evenly spaced, low mounds, showing no distinct grouping; seen from behind the apical saddle is pro-

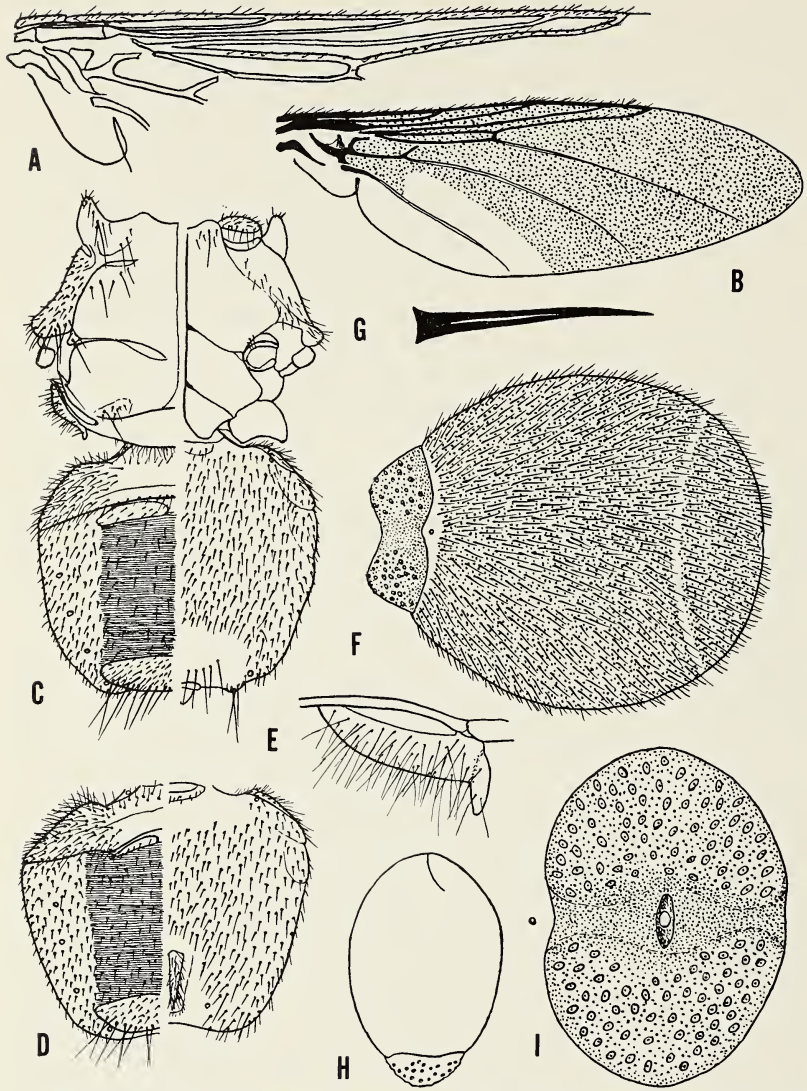

Fig. 93. *Olfersia bisulcata* Macquart. **A**, anterior part of wing, the microtrichia omitted, ♀, Panama City, on *Coragyps a. atratus;* **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally of same; **D**, abdomen dorsally and ventrally, ♂, Tapia, C.Z., on *Sarcoramphus papa;* **E**, left metanotal pleurotergite of same; **F-I**, puparium from fly on *Coragyps a. atratus,* Uvalde: **F**, dorsal view; **G**, one of the pointed hairs; **H**, side view, hairs and punctures omitted; **I**, peripneustic lobes from behind.

vided with a narrow, transverse depression, with a small, raised knob at the bottom.

In Part I (p. 160) I mentioned a male infested with mites. The following additional cases of mite infestation have been noted since.

2. A ♀ from La Vaca, Chiriqui, on *Sarcoramphus papa*, carried a ♀ mite, without eggs, on the upper side of the palpi, near the base, close to the tip of the frons.

3. A ♀ from Victoria, Caldas, on *Cathartes aura jota*, carried two ♀ mites, without eggs: one at the tip of the abdomen, close to the anal opening; the other on the upper side of the right fore femur, near the tip.

In Part I (p. 141) I recorded also one case of infestation with fungi (Laboulbeniales) and I discussed (pp. 254 and 318) the host-parasite relations.

Affinities. *O. bisulcata, O. fumipennis* and *O. fossulata* are closely related and few reliable differential characters can be added to those given in the key. The frons in particular is very similar in all three; but the striolate median area of the interantennal part is more extensive in *bisulcata* (Fig. 86*B*) than in *fossulata*, though about as in *fumipennis*. In all 3 species this striolate area is depressed and separated by a strong, blunt, smooth ridge from the antennal pit on each side; the depression extends as deep, broad grooves over the diverging, bluntly pointed sides of the frons. There is no significant difference in the venation or in the extent of the microtrichia on the membrane of the wing; but in *bisulcata* the 2nd basal cell is relatively shorter than in the others, being about half the length of the 1st basal cell; in all 3 species the 1st longitudinal vein ends far apicad of the anterior cross-vein and the posterior basal cross-vein is very oblique. In *bisulcata* the setae on the 3rd longitudinal vein are very small and easily overlooked; in some specimens they are restricted apparently to the apical section of the vein, but in others they may be traced also basad of the anterior cross-vein. The 3 species also agree in the chaetotaxy of the body: the orbital bristles are many and in two irregular rows; there is only 1 vertical bristle on each side near the postvertex; and a notopleural bristle is always present on the lobe between anepisternum and mesoscutum. The two soft lobes on the rim of the anal, apical or ventral sclerite in the ♀ are broad, short and more or less fused, sometimes almost completely so (as in Fig. 90*F*, *lo*, for *O. fumipennis*). The metanotal pleurotergite is shaped almost exactly alike in all 3 species.

Original description of *O. bisulcata* (French text translated): "Fusca. Facie fossulata. Thorace bisulcata. Pedibus rufis. Alis fuscis. Length 3 [French] lines [= 6.76 mm.]. Palpi extending slightly beyond the antennae. Face brown, with a small pit near the suture. Frons with a light green sheen. Thorax with a violaceous sheen. The two longitudinal furrows a short distance apart. Femora pale fulvous, somewhat greenish." Some years ago Mr. J.E. Collin examined the female type at my request, giving me information enabling me to synonymize with it van der Wulp's *O. vulturis*. He also recognized that the specimen which was labelled "*mexicana*" in the Bigot Coll., was cospecific with *bisulcata*. My own study of both these flies in 1951 confirmed Mr. Collin's conclusions. The wing of both is about 8 mm. long. Speiser (1902) had previously studied the same two specimens, which he placed as distinct species in *Pseudolfersia*. The name labels of both specimens appear to be in Macquart's handwriting. Nevertheless the fly labelled "*mexicana*" in the Bigot Coll. is not the type of that species, as it does not agree with the original description. The true type, in the Paris Museum, is a female of *Lynchia nigra* (Perty), as shown in my discussion of that species.

Original description of *O. vulturis*: "♀ Dark brown; front [interocular face] and eyes shining; first vein ending beyond the small [anterior] cross-vein; 3rd vein reaching costa at ⅔ its length. Length 6.5 mm. Nearly unicolorous dark brown; the eyes reddish-brown and shining; front [interocular face] somewhat shining, with an impressed line on both sides along the eyes and several impressions in the middle. Shoulders coniform, exserted; transverse suture of the thorax very distinct. Legs robust; femora thick, the hind pair longer than the others; claws black. Wings with a brown tinge; first vein reaching the costa distinctly beyond the small [anterior] cross-vein, which stands before the middle of the wing's length; second section of costa (from the humeral cross-vein to the end of the auxiliary vein [subcosta]) nearly as long as the 3rd section (from the end of the auxiliary vein to the end of the 1st vein); the two following sections (from the 1st to the 2nd vein and from the 2nd to the 3rd vein) shorter and of nearly equal length; the 3rd vein ending on the costa at ⅔ of its length; 2nd basal cell incomplete and retracted towards the base of the wing. Two specimens, one of which is labelled 'parasite of vulture.' This species seems to be allied to *Ornithomyia villadae* Dugès, which also belongs to the genus *Olfersia;* but its head is without metallic greenish tinge, and the legs are of the same colour as the body, whilst in *villadae* the two posterior pairs are black." I have examined the two types (♀ ♂) of *vulturis* at the British Museum in 1951. They agree in every detail with the common fly of American vultures for which I use Macquart's earlier name *bisulcata*. According to Dr. G.B. Fairchild (*in litt.*, Nov., 1953), the wing of the male is 7.8 mm. long and that of the female 8.7 mm.

Olfersia fossulata Macquart

Figs. 86*C–D*, 94*A–F* and 95

Olfersia fossulata Macquart, 1843, Mém. Soc. R. Sci. Agric. Arts Lille, (for 1842), p. 434 [1843, Dipt. Exot., 2, pt. 3, p. 277] (no sex; no host. Brazil. Type ♀ at Paris Mus.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 189 (copy of description). Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (in part: specimen from Galapagos: Daphne Major I., on *Pelecanus occidentalis californicus*). Curran, 1932, Nyt Mag. Naturvidenskab., **71**, p. 366. J. Bequaert, 1933, Psyche, **40**, pp. 102 and 105; 1933, Proc. California Ac. Sci., (4), **12**, p. 132; 1933, Rev. Chilena Hist. Nat., **37**, p. 164. Thompson, 1938, Ent. Mo. Mag., **74**, p. 43. J. Bequaert, 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 320 and 321; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1941, Occ. Papers Bernice P.

Bishop Mus., Honolulu, **16**, No. 11, pp. 271 and 272. Wolcott, 1941, Jl. Agric. Univ. Puerto Rico, **25**, pt. 2, p. 121 (Puerto Rico: Desecheo I., on *Sula l. leucogaster*). Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix). Wolcott, 1951, *Op. cit.*, **32**, (for 1948), pt. 3, p. 530. Donoso Barros, 1949, Rev. Méd. Chile, **77**, pt. 6, p. 404 (Chile: Isla del Alacran, Arica, biting Man). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (1950), p. 9.

Pseudolfersia fossulata Coquillett, 1901, Proc. Washington (D.C.) Ac. Sci., **31**, p. 379 (Galapagos: Wenman I.).

Olfersia forsulata "Macquart" Thompson, 1936, Ann. Mag. Nat. Hist., (10), **18**, p. 316 (error for *O. fossulata*).

Pseudolfersia maculata Murphy, 1921, Comp. Administr. Guano, **12a** Mem. del Directorio, Lima, p. 112 (Peru: on the Guano Islands, off the coast: Chincha, Mazorca, Pescadores, and Lobos de Afuera; on *Phalacrocorax bougainvillii, Sula variegata, Pelecanus occidentalis thagus* and *Larus belcheri*); 1925, Bird Islands of Peru, p. 250. Not of Coquillett, 1899.

Olfersia diomedeae Falcoz, 1930, Encyclop, Entom., Sér. B, Diptera, **5**, (for 1929), p. 46 (in part: only specimen from Santiago de Chile). Not of Coquillett, 1901.

Distribution and Specimens Examined. Panama: Canal Zone, without precise locality (C. Evelyn Cheesman).

Cocos I.: Wafer Bay (W.H. Osgood and D. Lambert).

Antilles. Puerto Rico (recorded by Wolcott, 1941, 1951): Desecheo I., on *Sula l. leucogaster* (S.T. Danforth). — St. Croix (recorded by Beatty, 1947): specimens seen (H.A. Beatty).

Brazil (recorded by Macquart, 1843): type ♀, without precise locality, at Paris Mus.

Ecuador: Guayaquil (C.L. Fagan).

Peru (recorded by Murphy, 1921): On board ship, off the coast, on *Sula variegata* (E.P. Reed); Chincha Is., without host (J. Ortiz de la Puente), on *Phalacrocorax bougainvillii* (G.S. Myers), on *Larosterna inca* (Templeton Crocker Exped., 1935) and on *Sula variegata* (Ac.Sci.Calif.); Lima, on *Tyto alba contempta* (W. Weyrauch); Cruz de Husco near Lima, on *Pelecanus occidentalis thagus* (R.C. Shannon); Lobos de Afuera, Chincha Is., from *Pelecanus occidentalis thagus* rookery (R.E. Coker); Mazorca I., Chincha Is., on *Larus belcheri* (R.C. Murphy); Pescadores, Chincha Is. (R.C. Murphy); Chincha Is., on *Phalacrocorax bougainvillii* (Martinez); Ancon, without host (E.S. Ross), on *Larosterna inca* (C.H.T. Townsend), and on *Phalacrocorax gaimardi* (R.H. Beck); San Lorenzo I. near Callao, on nesting sites of *Phalacrocorax bougainvillii* (W. Weyrauch); Pachacamac near Lima, on *Phalacrocorax bougainvillii* (W. Weyrauch); Chala, on *Larus belcheri* (W. Weyrauch); Río Lurin, on *Pelecanus occidentalis thagus* (W. Weyrauch).

Galapagos (recorded by Coquillett, 1901; Johnson, 1924).

Chile (recorded by Falcoz, 1930; Donoso Barros, 1949): Tofo, on *Pelecanus occidentalis thagus* (T. Hallinan); Lluta (Rosario); Arica (G. Kuschel; R. Donoso Barros); [Santiago (C.E. Porter. — Specimen at Paris Mus. recorded by Falcoz as *diomedeae;* a very doubtful record); Valparaiso (E.P. Reed; a very doubtful record)].

O. fossulata is mainly a Neotropical insect, ranging from Panama and Puerto Rico to northern Chile. The records from central Chile need confirmation. It has never been taken on a host in the United States; but I have seen a specimen found February 19, 1949, on a plane arriving at New Orleans from Balboa (according to Mr. J.H. Hughes, *in litt.*). There are few reliable records from the Old World, *viz.*, from the Philippine Is. (W. Schulze. — Specimen at U.S.Nat.Mus.) and from Wetter I., Indonesia (specimen at Amsterdam Zool. Mus.), unfortunately without indication of host.

Known American Hosts of *O. fossulata* (verified individual records in parentheses). Pelecaniformes (12): *Pelecanus occidentalis californicus; P. occidentalis thagus* (4); *Phalacrocorax bougainvillii* (4); *P. gaimardi* (1); *Sula l. leucogaster* (1); *S. variegata* (2). Charadriiformes (4): *Larosterna inca* (2); *Larus belcheri* (2). Strigiformes (1): *Tyto alba contempta* (1).

Bionomics. The small number of verified host records is misleading, as no doubt each lot consisted in most cases of flies pooled from several individual birds or caught in the open at nesting sites of the hosts. Actually *O. fossulata* is a common and abundant parasite of marine fish-eating birds. The several Pelecaniformes and Charadriiformes listed above are its usual and presumably only breeding hosts. They nest mostly in close proximity and often in enormous numbers in rookeries. Foremost among such nesting sites are the Guano Islands off the west coast of South America. Here the flies sometimes swarm over the bare ground, rocks and low vegeation of the rookeries, as well as over the young birds, so that it is difficult to decide whether any of the several species of birds nesting together in one place are preferred or more suitable breeding hosts. R.C. Murphy (1924, *National Geographic Magazine,* 46, p. 294) published a photograph of a guanay, *Phalacrocorax bougainvillii,* carrying several *O. fossulata* on the head. This picture is here reproduced by permission (Fig. 95). The following passage from the same author's "*Bird Islands of Peru*" (1925) also refers to this fly: "The feather flies are enor-

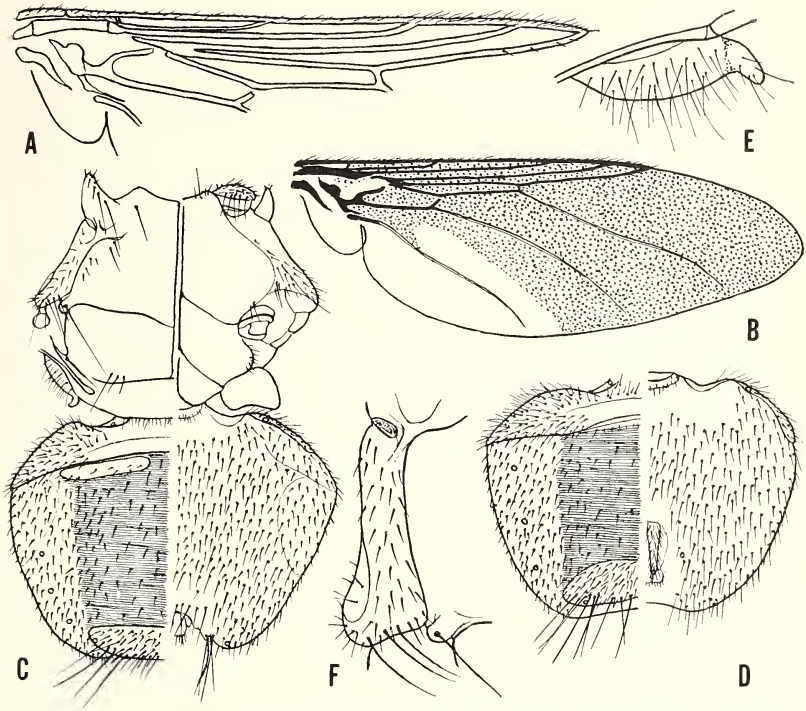

Fig. 94. *Olfersia fossulata* Macquart. **A**, anterior part of wing, the microtrichia omitted, ♀, Ancon, Peru, on *Phalacrocorax gaimardi;* **B**, wing of same; **C**, thorax and abdomen dorsally and ventrally, ♀, coast of Peru, on *Sula variegata;* **D**, abdomen dorsally and ventrally, ♂, Chinchas Is., on *Phalacrocorax gaimardi;* **E**, left metanotal pleurotergite, ♂, Lobos de Afuera, on *Pelecanus occidentalis thagus;* **F**, dorsal aspect of left anepisternum of same.

mously abundant; sometimes a dozen together can be seen sidling about the plumage of a nestling guano bird, and slipping in and out between the feathers in an uncanny way. On one December afternoon an inconceivable number covered the soil on the leeward slope of Mazorca Island. Practically no breeding birds occupied this side of the island, but there were colonies of both guanayes and piqueros on the windward exposure. The flies were so thick that hundreds dotted each square yard of ground. When I laid down my gun, it was immediately covered with the shiny, jerky creatures.'' The one record from an owl (*Tyto*) should be regarded as an accidental stray. The host relations were also discussed in Part I (p. 323).

Thus far I reported only one case of infestation with mites for this species (Pt. I, p. 160). Several more cases have now been observed. In fact mites are by no means rare on *O. fossulata;* but the infestation seems to consist usually of single mites, without egg clusters, a peculiarity for which I can offer no explanation at present.

2. Of a total of 22 flies from the Chincha Is., on *Phalacrocorax bougainvillii*, 5 carried mites, in 3 cases single ♀ without eggs and in the other 2, mites with egg clusters. In 2 ♂ and 2 ♀ flies the mites were fixed to the abdomen, either at the tip, or dorsally, or ventrally. In one a mite cluster was attached to the under side of the head at the base of a palp.

3. A ♂ from San Lorenzo I., taken in a rookery of *Phalacrocorax bougainvillii*, carried several mite clusters dorsally in the gap between head and thorax.

4. A ♂ from Lobos de Afuera, taken in a rookery of *Pelecanus occidentalis thagus,* carried a single mite without eggs on the abdomen ventrally.

5. A ♂ from Mazorca I., on *Larus belcheri,* carried 3 ♀ mites without eggs, 2 on the left side of the thorax at the base of the wing and 1 ventrally at the tip of the thorax behind the left hind coxa.

6. A ♀ from Arica, host unknown, carried one mite without eggs on the dorsum of the abdomen.

The puparium is as yet unknown.

Donoso Barros (1949) reported the interesting case of a workman on Isla del Alacran, a guano island near Arica, Chile, who complained of intermittent itching at reddish blotches of the skin, followed later by papules. These symptoms resulted from the bites of *Olfersia fossulata*, some of which were found in the man's clothing. I have seen some of the specimens of this case.

Affinities. These have been discussed at some length for *O. fumipennis* and *O. bisulcata*, the two close relatives of *O. fossulata.* While there is no reliable difference in the 3 species in the shape of the combined lunula and interantennal frons, in *O. fossulata* (Fig. 86*D*) the striolate median area is markedly narrower in the upper part than in the other two. In the wing, the 2nd basal cell is over half the length of the 1st; and setulae occur on the 3rd longitudinal vein apicad only of the anterior cross-vein and often on the apical half only of this terminal section.

Original description of *O. fossulata* (French text translated): "Nigra virescens, Facie fossulata. Pedibus alisque fuscis. Length

Fig. 95. *Olfersia fossulata* Macquart, on *Phalacrocorax bougainvillii*, Chinchas Is. Photograph by Dr. Robert C. Murphy; reproduced by permission.

$2\frac{3}{4}$ French lines [= 6.2 mm.]. Proboscis not protruding. Face black, shiny; a small cavity near the suture separating the frons; a small spot of whitish pilosity at the insertion of the antennae. Frons shiny black, with greenish sheen; the sides dull black. Head brownish beneath. Thorax with greenish sheen; breast brownish. Abdomen brown. Legs black above, greenish fulvous beneath. Wings blackish; inner margin [hind margin] pale yellow." The type, recently (1951) seen at the Paris Museum, is a female (so far as could be ascertained), showing all the characters here attributed to the species.

Olfersia sordida Bigot

Figs. 14*E*, 84*D*, 85*D* and 96*A–H*

Olfersia sordida Bigot, 1885, Ann. Soc. Ent. France, (6), **5**, p. 239 (no sex; no host. Guatemala. Type ♂ from Bigot Coll., now in J.E. Collin Coll.). Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, pp. 192 and 194 (copy of description). J. Bequaert, 1933, Psyche, **40**, pp. 101 and 103; 1940, Rev. Acad. Colombiana Ciene. Ex. Fis. Nat., **3**, No. 12, p. 416; 1940, Mem. Soc. Cubana Hist. Nat., **14**, No. 4, pp. 319 and 321; 1941, Occ. Papers Bernice P. Bishop Mus., Honolulu, **16**, No. 11, p. 271, figs. 2*a–c;* 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 81. Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, (for 1944), pts. 3–4, p. 155 (St. Croix).

Pseudolfersia sordida Speiser, 1902, Zeitschr. Syst. Hym. Dipt., **2**, p. 164

(type). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Pseudolfersia spinifera Johnson, 1908, Psyche, **15**, p. 80 (in part: specimens on cormorant, Bahamas); 1922, *Op. cit.*, **29**, p. 85 (same Bahamas specimens). Not of Leach, 1817.

Olfersia fossulata Johnson, 1924, Zoologica, New York, **5**, No. 8, p. 91 (in part: specimens on cormorant, Bahamas). Not of Macquart, 1843.

Distribution and Specimens Examined. United States. Florida: Merritt I., Brevard Co., on young *Pelecanus occidentalis carolinensis*, September 19 (D.J. Nicholson); Pine I., Punta Gorda, Charlotte Co., on *Pelecanus occidentalis carolinensis* (R. Archbold). — Louisiana: Pass-a-L'Outre, Plaquemines Parish, on *Pelecanus occidentalis carolinensis* (C.S. Hathaway). — Received from F.H. Wilson). — Oregon: Camp Harney, Harney Co. (C. Berchin). — Texas: Galveston, Galveston Co., on *Pelecanus occidentalis carolinensis* (R.W. Strandtmann). — Utah: Antilope I., Davis Co. (I. Berryman). — Also Florida: Gainesville, Alachua Co., 6 ♀, 3 ♂, on *Strix varia georgica* (O.E. Baynard).

Mexico: Sta. Lucrecia, State Vera Cruz (E.G. Smyth); San Blas, State Nayarit, on *Pelecanus occidentalis californicus* (G.F. Ferris).

Guatemala (recorded by Bigot, 1885): without precise locality (J. Deby).

Panama: San José, Pearl Ids., Gulf of Panama, on *Leucophoyx t. thula* (R.C. Murphy); Barro Colorado, C.Z., on *Pelecanus occidentalis californicus* and *Phalacrocorax olivaceus* (J. Van Tyne); Panama City, on *Pelecanus occidentalis californicus* (L.H. Dunn); near Taboguilla and Otoque Is., Panama Bay, on *Pelecanus occidentalis californicus* (A.D. Foster, through L.E. Rozeboom); Paitilla Point, Panama City, on rocks where cormorants were nesting.

Antilles. Bahamas (recorded by Johnson, 1908, 1922, 1924): Great Salt Cay, on *Phalacrocorax auritus floridanus* (T. Barbour, G.M. Allen and O. Bryant). — Cuba: near Cape San Antonio, Prov. Pinar del Río, on *Pelecanus o. occidentalis* (D.D. Davis). — Isle of Pines: Hanal Bay, Los Indios, on *Phalacrocorax auritus floridanus* (G. Link). — Jamaica: without precise locality (Shoemaker). — Hispaniola: Beata I., on *Pelecanus* sp. — St. Thomas: Drift Bay, Water I. (Shoemaker). — St. Croix (recorded by Beatty, 1947): Christiansted (H.A. Beatty).

Venezuela: Puerto La Cruz, D.F., Caracas, on *Pelecanus o. occidentalis* (E.G. Holt).

Trinidad: North Manzanilla (E. McC. Callan); without precise locality, on *Pelecanus o. occidentalis* (F.W. Urich).

Galapagos: Indefatigable I. (L. Evelyn Cheesman); James I. (L. Evelyn Cheesman).

Brazil: Piquiri, State Matto Grosso (Inst. Osw. Cruz).

O. sordida is mainly a Neotropical insect, occurring on both the Pacific and the Atlantic coasts. It is very rare and presumably only accidental north of 30° N. It is not known south of the Tropic of Capricorn nor from the Old World.

Known Hosts of *O. sordida* (verified individual records in parentheses). Pelecaniformes (14 and 1 unidentified pelican): *Pelecanus o. occidentalis* (3); *P. occidentalis californicus* (4); *P. occidentalis carolinensis* (4); *Phalacrocorax auritus floridanus* (2); *P. olivaceus* (1). Ciconiiformes (1): *Leucophoyx t. thula* (1). Strigiformes (1): *Strix varia georgica* (1).

Bionomics. Although *O. sordida* is probably by no means rare, there are not many individual host records. The majority of these are from pelicans, which are definitely its true breeding hosts. Cormorants possibly also serve as such, but the records are too few to be conclusive. The single record from a snowy egret I regard as an accidental stray. The puparium is unknown. The host relations are briefly discussed in Part I (p. 320). The unusual occurrence of several flies on a Florida barred owl may perhaps be explained by the similar nesting habits of this owl and the Florida brown pelican. Both often nest in low trees in similar situations; occasionally the owl even uses an abandoned tree nest of some other large bird.

I have observed 2 infestations with mites on *O. sordida:*

1. A ♀ from Galveston, Texas, on *Pelecanus occidentalis carolinensis*, carried a ♀ mite with an egg cluster on the under side of the head, fixed to the middle of the gula at the base of the proboscis.

2. A ♂ from Jamaica, on *Pelecanus o. occidentalis*, carried a mite with an egg cluster at the tip of the abdomen.

O. sordida also appears to be particularly prone to infestation with Laboulbeniales of the genus *Trenomyces*, since in the relatively limited material examined 12 flies were infested with these fungi:

a. The ♀ from Galveston, on *Pelecanus occidentalis carolinensis*, mentioned above as infested with mites, also carried several small patches of fungi on the dorsum of the abdomen.

b. A ♀ from Pass-a-L'Outre, Louisiana, on *Pelecanus occi-*

dentalis carolinensis, carried small patches of fungi on the dorsum of the abdomen.

c. A ♀ from Great Salt Cay, Bahamas, on *Phalacrocorax auritus floridanus*, carried small patches of fungi on the hind dorsal sclerite of the abdomen.

d. All 6 ♀ and 3 ♂ from Gainesville, Florida, on *Strix varia georgica*, carried patches of fungi on the dorsum of the abdomen.

Affinities. Although *O. sordida* is a true *Olfersia* in all essential features, it is isolated in the genus owing to several unusual characters. The peculiar structure of the basal sclerites of the abdomen, the bulging 1st basal cell, the setulae on the 4th longitudinal vein and the absence of a notopleural bristle on the lobe between anepisternum and mesoscutum are unique features. The bulge of the 1st basal cell recalls that of the tsetse-flies (Glossinidae), where it is, however, much more pronounced and a family characteristic. The shape of the combined lunula and interantennal frons (Fig. 84*D*) is also distinctive, with the apical margin divided by a deep median notch into two broadly rounded sides; the median striolate area occupies most of the surface of the interantennal frons, but is only slightly depressed and not grooved apicad. The following additional characters may also be mentioned. First longitudinal vein reaching costa opposite or slightly basad of anterior cross-vein; 2nd longitudinal vein ending much nearer tip of 3rd than of 1st; 3rd and 4th longitudinal veins completely fused over a short stretch at base of 1st basal cell; basal section of 5th longitudinal vein not or only slightly shorter than 2nd section of 4th; anterior basal cross-vein very oblique; setulae on the longitudinal veins usually better developed than in the congeners (Figs. 96*A–B*). In Fig. 96*B* the area of the postaxillary cell and alula covered with microtrichia on the under surface only of the membrane is indicated by more spaced stippling. The chaetotaxy is more developed than in the other species of the genus, particularly on the inner orbits (Fig. 85*D*) and dorsally on the thorax, where the bristles are placed in conspicuous patches of dull, grayish, densely matted, microscopic hairs; a streak of similar, dull hairs along the unusually deep transverse mesonotal suture; minute, dull hairs also cover the basal sclerite of abdomen. Usually 2 (rarely 1) vertical bristles at each side of postvertex. The median striolate area of the abdomen dorsally (Figs. 96*C* and *E*) is less extensive than in the congeners. The metanotal pleurotergite is distinctive (Fig. 96*D*), the basal attached portion being low and rather flattened, while the protruding free "thumb" is

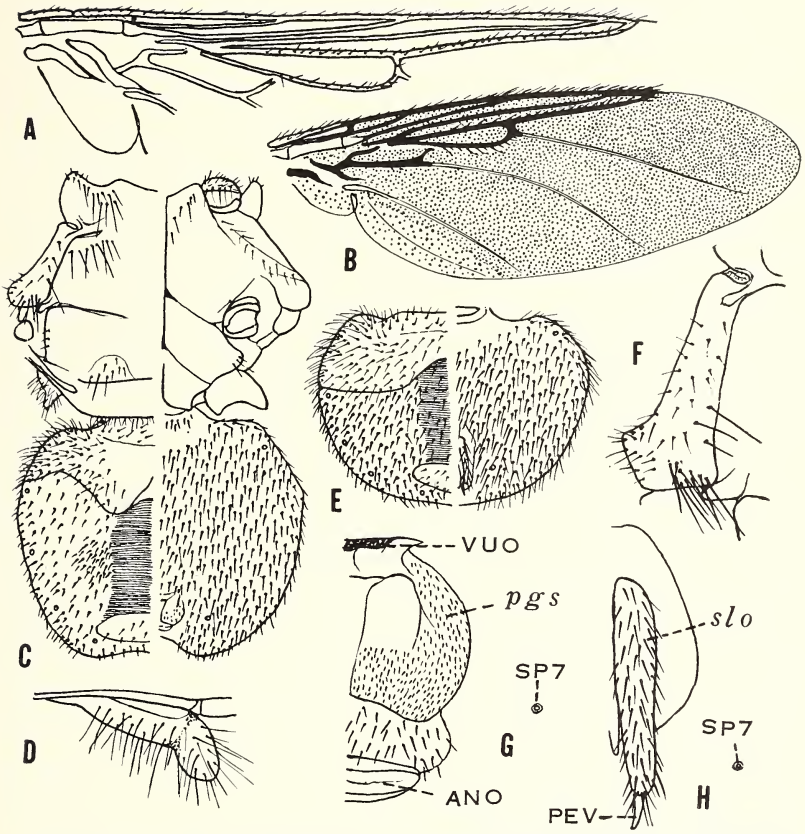

Fig. 96. *Olfersia sordida* Bigot. **A**, **B** and **E**, Trinidad, on *Pelecanus o. occidentalis;* **C**, **D** and **F**, Great Salt Cay, on *Phalacrocorax auritus floridanus;* **G** and **H**, Panama City, on *Pelecanus o. occidentalis:* **A**, anterior part of wing, the microtrichia omitted, ♂; **B**, wing of ♂; **C**, thorax and abdomen dorsally and ventrally, ♀; **D**, left metanotal pleurotergite, ♀; **E**, abdomen dorsally and ventrally, ♂; **F**, dorsal aspect of left anepisternum, ♀; **G**, one side of ventral ano-genital area, ♀: *ANO*, anal opening; *pgs*, paragenital sclerite; *SP7*, 7th abdominal spiracle; *VUO*, vulvar opening; **H**, one side of ♂ terminalia, in folded condition: *PEV*, penis valve; *slo*, setigerous lobe; *SP7*, 7th abdominal spiracle.

larger and thicker than usual. In the ♀ the venter of the abdomen bears apically, between the saucer-shaped anal sclerite and the vulvar opening, a much enlarged paragenital sclerite (Fig. 96*G*, *pgs*), with a median pair of raised, strongly sclerotized, bare and smooth areas; but the rim of the anal sclerite seems to lack the usual pair of free or fused lobes. In the ♂ the setigerous lobes are decidedly more slender throughout than in the other species of *Olfersia* (Fig. 96*H*, *slo*).

Original description of *O. sordida* (French text translated): "Long. 5 mm. Antennis fuscanis, flavo pallido villosis; toto corpore nigro fusco, thorace nitido; femoribus basi lividis; alis fuscanis, venis, costali, longitudinalibus 1-4is, omnino, 5a et 6a, usque ad venas transversas nigras, nigro tinctis. — Entirely blackish-brown, except for the shiny thorax; antennae brown, with yellowish hairs; a rounded, shiny disk placed above the epistome [frons] bearing a median deep pit, the vertex entirely covered by a broad trapezoidal shiny plate; eyes blackish. Scutellum without setae. Legs blackish, femora livid-yellow at the base, with some short, russet setae; wings smoky; the costa, 1st, 2nd, 3rd, and 4th longitudinals, and the two cross-veins entirely black, the 5th and 6th longitudinals of this color only as far as the cross-veins. First longitudinal fused to the costa opposite the 1st [anterior basal] cross-vein; 2nd longitudinal fused to the costa far from the 1st longitudinal; the two basal cells very unequal." Some years ago, Mr. J.E. Collin examined the male type at my request and compared it with a male from Jamaica now at the U.S. Nat. Mus. He found that it has all the characters mentioned for the species in my key. He stated in particular that "the first tergal plate has an open Λ-shaped excision in the hind margin," a character not found in any other species of *Olfersia*. All this I was able to confirm recently (1951) by a personal study of the type. Speiser (1902) also saw it, but some of his statements are misleading, particularly his description of the 2nd basal cell ("hintere Basalzelle").

Olfersia coriacea van der Wulp
Figs. 7*F*, 84*B* and 97*A–I*

Olfersia coriacea van der Wulp, 1903, Biol. Centr.-Amer. Diptera, **2**, p. 430; Pl. 13, figs. 2–2*a* (doubtfully as ♀, really ♂; no host. In part: Guatemala: Mirandilla, figured ♂ only, selected as the true type [holotype] by Austen, 1903. [The ♂ cotype from Presidio, Mexico, is *Olfersia propinqua* Walker = *Lynchia albipennis*]. Types in Brit. Mus.). J. Bequaert, 1932, Psyche, **38**, (for 1931), pt. 4, p. 187; 1933, *Op. cit.*, **40**, pt. 3, pp. 103 and 105; 1933, Carnegie Inst., Washington, Publ. No. **431**, p. 569; 1938, *Op. cit.*, Publ. No. **499**, p. 227; 1940, Rev. Acad. Colombiana Cienc. Ex. Fis. Nat., **3**, No. 12, p. 416; 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 82. Fuentes Novella, 1944, Rev. Agric., Dir. Gen. Agric., Guatemala, (2), **1**, No. 1, pp. 13–14 (Guatemala). Beltrán, 1944, Scientific Monthly, **59**, p. 116 (Mexico: Yucatan). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Biagi, 1953, Leishmaniasis Tegumentaria Mexicana, p. 62 (Mexico: Campeche).

Pseudolfersia coriacea Austen, 1903, Ann. Mag. Nat. Hist., (7), **12**, p. 265 (types; figured ♂ from Mirandilla, Guatemala, selected as holotype. Mexico: Orizaba, ♀. Brazil: Rio Tapajos, ♀). Aldrich, 1905, Smithson. Misc. Coll., **46**, No. 1444, p. 656. Speiser, 1907, Ent. News, **18**, p. 104; 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Pseudolfersia meleagridis Lutz, Neiva and da Costa Lima, 1915, Mem. Inst. Osw. Cruz, **7**, p. 179; Pl. 27, fig. 3 (no sex. Brazil: interior of State Pernambuco, on domestic *Meleagris g. gallopavo;* São-Luis-do-Maranhão, State Maranhão, on Man; State Minas Gerais or Espirito Santo, on *Tinamus solitarius;* cotypes at Inst.Osw.Cruz, Manguinhos near Rio de Janeiro; 1 ♂ cotype at U.S.N.M.). Lutz and Penna, 1918, *Op. cit.*, **10**, p. 85 (Brazil: Socorro, State Pernambuco, on domestic *Meleagris gallopavo*). Neveu-Lemaire, 1938, Traité Entomologie Médicale Vétérinaire, p. 983.

O. coriacea was also figured, without name, from a Yucatecan specimen by E. Farfán y López (1922, p. 13; dorsal and ventral view).

Olfersia mexicana Macquart (1843) was not based on *O. coriacea*, as I suspected at one time. What I regard as the true type of *mexicana*, at the Paris Museum, agrees with *Lynchia nigra* (Perty), as shown in Part II, pp. 325–326.

Distribution and Specimens Examined. Mexico (recorded by Austen, 1903; Farfán y López, 1922; Beltrán, 1944; Biagi, 1953): Orizaba, State Vera Cruz (Brit.Mus.); Volcano Colima, State Colima (Joh. Laue); Oaxaca, State Oaxaca, several flies taken on Man (Mrs. Ruth Oberg); Hato Frontera, State Chiapas, on *Penelope p. purpurascens* (Esc.N.Biol.Mex.); Matamoros, State Campeche, on *Ortalis vetula pallidiventris* (Esc.N.Biol.Mex.); El Tormento, 8 Kilom. W. of Escárcega, State Campeche, 1 ♀ on *Ortalis vetula pallidiventris*, Dec. (Julio Sosa); Kilom. 38 of Pital-Matamoros road, 9 Kilom. W. of Escárcega, State Campeche, 4 ♀ on *Agriocharis ocellata,* April 2 (Concepción Hernandez); on Pital-Matamoros road, 3 Kilom. W. of Escárcega, State Campeche, 1 ♂ on Man, but not biting, April 24 (Manuel J. Jas); 30 Kilom. N. of Candeleria, State Campeche, 1 ♂ on Man, but not biting, May (Oscar Silva); 16 Kilom. S.W. of Escárcega, State Campeche, 1 ♂ on Man, but not biting, March 18 (Angel Taje); [most of the flies from Campeche were seen through the kindness of Mrs. Ana María de Buen de Biagi]; Colonía Santa María, near Puerto Morelos, State Quintana Roo (G.C. Shattuck); Chetumal, State Quintana Roo (R.A. Paynter, Jr.); 24 Kilom. N.W. of Xtocomo, State Quintana Roo (R.A. Paynter, Jr.); State Quintana Roo (Herrera, 1919).

British Honduras: Gallon Jug, ♀ on *Agriocharis ocellata* (S.M. Russell).

Guatemala (recorded by van der Wulp, 1903; Fuentes Novella, 1944): Yaloche, Dept. Peten; Peten (O. Ricketson, Jr.); Uaxactun, Dept. Peten, on *Crax r. rubra* (J. Van Tyne); Mirandilla, about 15 miles N.W. of Escuintla, 1700 ft. (G.C. Champion. — Lectotype ♂ of *coriacea* at Brit.Mus.).

Panama: Juan Diaz (T. Hallinan); Upper Chagres River, on *Agriocharis ocellata* (H.L. Clark).

Colombia: San-Juan-de-Arama, Int. del Meta, on *Crax nigra* (E. Osorno); La Cueva, Sa. Marta, Dept. Magdalena, on *Crax a. alberti* (M.A. Carriker).

Venezuela: Yagua (H.A. Beatty).

British Guiana: Kartabo, on *Crax nigra* (W. Beebe); source of Essequibo River (J. Ogilvie); Upper New River, a tributary of the Courentyne River (E.R. Blake) and on *Crax nigra* (J.G. Myers).

Dutch Guiana: left bank of Upper Coppename River, on *Crax nigra* (D.C. Geijskes).

Brazil (recorded by Austen, 1903; Lutz, Neiva and da Costa Lima, 1915; Lutz and Penna, 1918): Rio Tapajos (Brit.Mus.); Pernambuco, on domestic turkey, *Meleagris g. gallopavo* (Ad. Lutz. — ♂ cotype of *meleagridis*, at U.S.Nat.Mus.); 1 ♂ caught in house (R.C. Shannon); Maracajú, State Matto Grosso, on *Crax* sp. [? *fasciolata*] (R.M. Gilmore); Descalvados, Rio Paraguay, State Matto Grosso, on *Crax fasciolata* (J.A.G. Rehn); Parahyba (C. Moreira); Ceará-Mirim, State Rio Grande do Norte, on domestic turkey, *Meleagris g. gallopavo* (D.C. Alves); State Goyaz, on *Crax fasciolata;* Coxim, State Matto Grosso, on *Mesembrinibis cayennensis* (J. Lima).

Bolivia: Río Colorado, on *Penelope* sp. (W.M. Mann).

Peru: Pucallpa and Aguaytia, Tingo María (E.J. Hambleton).

O. coriacea is a strictly Neotropical fly, known on the American continent from southern Mexico (19° N.) to Bolivia and Matto Grosso (22° S.).

Known Hosts of *O. coriacea* (verified individual records in parentheses). Tinamiformes: *Tinamus solitarius.* Ciconiiformes (1): *Mesembrinibis cayennensis* (1). Galliformes (18): *Agriocharis ocellata* (3); *Crax* sp. (1); *Crax a. alberti* (1); *C. fasciolata* (2); *C. nigra* (4); *C. r. rubra* (1); *Meleagris g. gallopavo* (2, in domestication); *Ortalis vetula pallidiventris* (2); *Penelope* sp. (1); *P. p. purpurascens* (1).

Bionomics. Although precise information, with specific identification of hosts, is as yet limited, it shows conclusively that *O. coriacea* uses only Galliformes of the families Cracidae and Phasianidae as true breeding hosts. As some of these birds are large and favorite game, the fly is one of the few hippoboscids known to laymen, particularly as it is prone to fly on people. It has been taken occasionally on domestic turkey in Brazil, where turkeys

do not now occur in the wild state; but there is no record thus far of its being found on wild turkeys in Mexico. The single records from tinamou and carauna in Brazil are clearly based on accidental strays, if at all trustworthy.

Straying of *O. coriacea* to Man was noted by Lutz, Neiva and da Costa Lima (1915) in Brazil, and has been observed often in Central America. It is frequently claimed to bite people. Possibly it may do so at times; but I have been unable to trace a fully reliable case of a fly actually sucking blood on a human. Mrs. Ana María de Buen de Biagi, who had much opportunity of observing this fly in nature, informs me (*in litt.*, 1954) that of the several specimens which she saw alight on people, none ever attempted to bite. Entomophobia is so prevalent among laymen, that I suspect that in most cases of so-called "bite" the fly was merely irritating by scratching the skin with its sharp claws. The matter is of some practical importance in view of the opinion, widely held in Yucatan and northern Guatemala, that the "mosca chiclero" (*O. coriacea*) is the transmitter to humans of cutaneous leishmaniasis ("bay sore" or "ulcera de los chicleros"). I discussed this problem in Part I (pp. 345 and 353), reaching the conclusion that all trustworthy evidence, experimental and other, is at present opposed to the view that *O. coriacea* is involved in the transmission of the disease.

To the one case of mite infestation mentioned in Part I (p. 160) the following may be added:

2. A ♂ from San-Juan-de-Arama, Colombia, on *Crax nigra*, carried 2 ♀ mites, without eggs, on the right side of the abdomen, close to the preänal sclerite.

O. coriacea has now also been found infested with Laboulbeniales of the genus *Trenomyces*. A ♂ from Maracajú, Brazil, on *Crax* sp., carried a large patch of these fungi on the venter of the abdomen, close to the thorax.

I have seen puparia or full-grown larvae from Mexico and Bolivia. They show no essential difference in shape and hirsuteness from those known of other species in the genus. The fully sclerotized and colored puparium (Fig. 97*I*) is broadly elliptical, 3.5 mm. long and 2.4 mm. wide. The saddle between the two polypneustic lobes is somewhat deeper than in *O. bisulcata*. The hairs and punctures of the integument are as in *O. spinifera* and *O. fumipennis*, the hairs being long, thin and stiff, each at the tip with a pair of minute, diverging barbs, which break off very easily.

Affinities. In view of the peculiar interest attaching to this

species, it is here described more fully than its congeners.

Smallest species of *Olfersia*, with rather long and narrow wings; 3rd and 4th longitudinal veins bare; 2nd basal cell long, the anterior basal cross-vein very short and nearly vertical. Interocular face narrow, only slightly wider than an eye; upper orbits and occiput not appreciably produced behind; postvertex divided by a curved, transverse depression; combined lunula and frons longer and narrower than usual, with a broad, triangular apical notch. Antennae unusually short.

Male. Head and thorax dorsally yellowish-brown to pale mahogany, sometimes somewhat coppery, pale dirty-yellow ventrally; lower half of interocular face, occipital margin, a median longitudinal line on mesonotum, humeral callosities and dorsal area of anepisternum more or less testaceous. Legs testaceous, tarsi darker; claws black. Abdomen testaceous; posterior sclerites blackish-brown. Setae mostly black; those of frons and middle of mesonotum testaceous.

Head (Fig. 97*D*) elliptical seen in front, slightly wider across the eyes than high from occiput to base of palpi. Posterior orbits very narrow, evenly curved, not projecting behind. Postvertex extending as one continuous, sclerotized plate from occiput to ptilinal suture, divided at its lower third by a crescent-shaped transverse depression, the anterior (or lower) area dull, microscopically alutaceous, the remainder smooth, shiny. Membranous mediovertex reduced to narrow lateral triangles. Sclerotized inner orbits narrow; inner margin with 8 to 10 soft, short setae, mostly placed in one row; one vertical bristle on each side near upper corner of postvertex. Occipital margin of postvertex evenly rounded, scarcely more projecting behind than upper orbits and separated from them by shallow inward curves. Combined lunula and frons (Fig. 84*B;* corrected from Fig. 7*F*) nearly as long as postvertex, basally with a large, deep median pit; anterior half divided longitudinally into two broad arms, which are contiguous over basal two-thirds and diverge at apex in two triangular, bluntly pointed lobes; surface of apical lobes flattened, slightly grooved, in part minutely striolate. Antennae much shorter than antennal pits; 1st segment completely divided by a deep suture from sides of frons; appendage of 2nd segment short, broadly rounded at apex, ending far from tip of apical lobe of frons, bearing many, very strong, curved setae. Palpi short and thick, protruding a short distance beyond frons, with a few, short setae. Eye broad; interocular face about $1\frac{1}{4}$ of the width of an

eye, the sides very slightly diverging toward occiput. Ventrally, postgenae on each side anteriorly with 1 strong seta and some soft hairs on the ridge bordering the buccal cavity; farther back, a few soft hairs and another strong seta about midway between buccal cavity and occipital foramen. Thorax (Fig. 97*C*): humeral callosities with the protruding lobes short, broad, very bluntly pointed, set off by an inner saddle-like depression, with a few scattered, black setae and 1 or 2 longer bristles; the inner area with a few setae and one long bristle; anterior margin of mesonotum slightly sinuate in the middle, the angles limiting the sinus very low and evenly rounded; transverse mesonotal suture deep, groove-like, but much finer medially; median notal suture a slightly raised line; prescutum with few, weak, pale setae anteriorly on the sides behind the incomplete posthumeral suture; notopleural lobe (at outer hind angle of prescutum) short, broad, bearing one very long bristle; mesoscutum with one postalar bristle, one long, pale hind dorsal bristle and a few minute setae nearby; dorsal area of anepisternum narrow, with prominent, broadly rounded hind angle, bearing scattered, short, black setae (mesopleural bristles), the setae stronger on the hind angle where one of them is very long. Disk of scutellum bare; hind margin sparsely fringed with soft, short hairs. Inner free process of metathoracic pleurotergite (Fig. 97*F*) long, narrow, blunt at tip. Thorax ventrally almost bare; intercoxal lobes of prosternum with a pair of long, soft setae; a similar seta on each side of mesosternum some distance from mid coxa. Legs covered fairly uniformly and sparsely with short hairs; fore coxa with a row of 4 setae ventrally; fore femur dorsally with a longitudinal row of 4 setae in the apical half anteriorly and, about the middle, with a transverse row of 2 or 3 shorter setae; outer face of fore tibia with a row of 4 or 5 long, soft setae; femora of mid and hind legs with a similar arrangement of weaker setae; apical spur of all tibiae short but strong, weakest on fore tibia; hind tibia in addition with an apical comb of short, strong setae. Wing (Figs. 97*A–B*) about 3 times as long as wide, slightly smoky, with a yellowish tinge; veins testaceous; membrane mostly covered with microtrichia, both on upper and under surfaces; only entire postaxillary cell, alula and a narrow zone (covering about $\frac{1}{5}$ of cell, but not reaching the base) along inner hind margin of combined 3rd posterior, anal and axillary cells bare; costa densely covered with short setae in its apical $\frac{2}{3}$, sparsely setulose at base; other veins bare; subcosta complete, ending in costa nearly opposite anterior basal cross-vein; 1st longitudinal reaching costa a

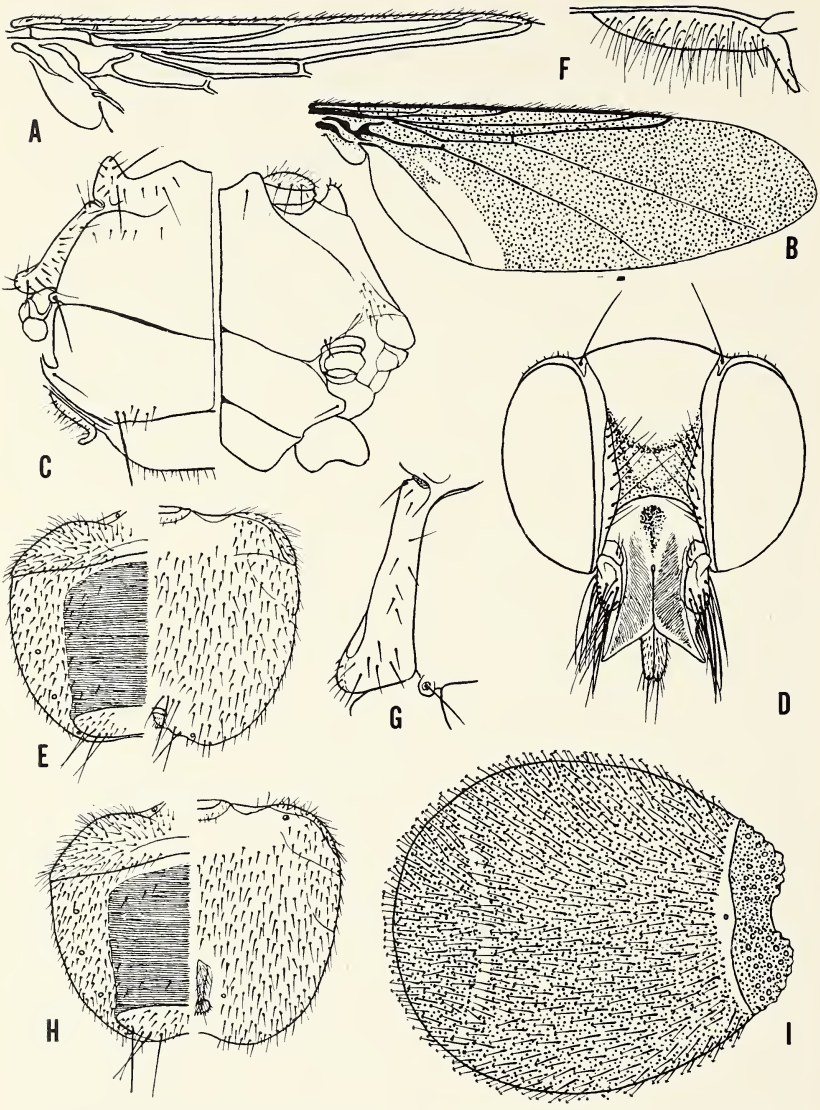

Fig. 97. *Olfersia coriacea* van der Wulp. **A**, anterior part of wing, the microtrichia omitted, ♂, Essequibo River; **B**, wing of same; **C**, thorax dorsally and ventrally, ♀, Maracajú, on *Crax* sp.; **D**, head, ♀, Gallon Jug, on *Agriocharis ocellata;* **E**, abdomen dorsally and ventrally, ♀, Yaloche; **F**, left metanotal pleurotergite of same; **G**, dorsal aspect of left anepisternum of same; **H**, abdomen dorsally and ventrally, ♂, Hato Frontera, on *Penelope purpurascens;* **I**, puparium from fly with same data.

short distance basad of anterior cross-vein; 2nd longitudinal ending much nearer tip of 3rd than of 1st; 1st basal cell very narrow, parallel-sided; 2nd basal cell rather long, nearly parallel-sided, about as long as its distance from the anterior cross-vein. Abdomen (Fig. 97*H*): combined 1st and 2nd laterotergites forming one transverse plate, with a median, rather deep inward curve, bare in the middle, the sides covered with scattered hairs; no small median sclerites behind this; preänal tergite large, strongly sclerotized, smooth and shiny, elliptical, divided medially by a slight, longitudinal, saddle-shaped depression, covered uniformly with sparse, short hairs and on each side before the apical margin with a transverse row of 3 or 4 long setae; remainder of dorsum soft, without sclerotized plates, but with a large median, almost bare area covered with very fine transverse striations; the sides with scattered, short hairs; venter soft, uniformly but sparsely covered with short hairs; genitalia as in other species of the genus. In addition to the hairs and bristles, dull, pollinose patches of dense, soft, microscopic, appressed hairs, on the following parts of head and thorax: inner, bristly portion of antennal appendage; area bearing inner orbital bristles; area around vertical bristle; inner saddle setting off humeral lobes; a narrow transverse area behind posthumeral suture; groove of transverse mesonotal suture; a small area on each side before scutellum; most of dorsal anepisternum; and much of mesopleura.

Length (from tips of palpi to hind margin of scutellum), 3 mm.; of wing, 6.5 to 7 mm.; width of wing, 2 to 2.5 mm.

Female. Differing from the male only as follows. Basal tergite of abdomen shorter; preänal tergite shorter, more transverse, posteriorly on each side with a group of 4 or 5 long setae.

Length (from tips of palpi to hind margin of scutellum), 3.5 mm.; of wing, 6.8 to 8 mm.; width of wings, 2.2 to 3 mm.

Original description of *O. coriacea:* "Brown, with the legs rufous and the wings brownish; first vein ending above the small cross-vein; third vein reaching the costa at three-fourths of its length. Length 4–5 mm. Dark brown; the eyes, the front [interocular face] (except its middle part), and the thorax glossy. Thorax before the transverse suture with two impressions on the disc; on the shoulders a rufous coniform prominence, with some short bristles at the tip; before the scutellum a longitudinal impressed line and on each side a rather deep impression with some small scratches. Legs rufous, the third femora elongate. Wings brownish; first vein ending above the small [anterior] cross-vein, which stands nearly at the middle of the wing's length, the auxiliary vein [subcosta] ending much nearer the base of the wing; third vein reaching the costa at three fourths of its length; second basal cell half as long as the superior [first] basal cell; beneath the end of the third vein a brown oblique shadow (in one of the specimens this is very distinct, in the other it is less conspicuous)." The original two cotypes, seen at the British

Museum in 1951, are, as Austen (1903) recognized, not cospecific, belonging even to different genera. The male from Guatemala, selected by Austen as the holotype and from which v. d. Wulp's figures were drawn, is the species of *Olfersia* common on game birds in tropical America. According to Dr. G.B. Fairchild, who examined it again in November, 1953, the wing is 7 mm. long, with a complete subcosta.

Original description of *P. meleagridis* (translated from the Portuguese): "General color that of coffee with a little milk added; similar to the *Lynchia* of domestic pigeon [*Pseudolynchia canariensis*], but with the characters of *Pseudolfersia* [= *Olfersia*]. Length 5 mm.; of head and thorax 3 mm. Head rather widened. Palpi blackish, a little shorter than half the head. Process of clypeus [frons] long, ending in two points, which are a little elongate and very divergent. Antennae with tufts of dark hairs. Triangles of frons [face] rounded, shaped like a half-moon or a segment of a circle; anterior triangle pale mahogany, with a darker and rather deep median depression; posterior triangle darker, particularly over the anterior half, and without anterior incision; lateral margins of frons [inner orbits] convex toward the inside with a row of small bristles and a larger one behind. All these parts polished and shiny; remainder of frons [face] with the surface finely granulose, about as long as wide. Eyes small, dark, but with a glossy sheen, slightly converging anteriorly. Occiput laterally with short black spines, medially with fine light bristles. Under side of head light ochraceous-gray, somewhat granulose, with some dark long bristles. Mesonotum with a metallic greenish gloss, rather smooth, but with many microscopic furrows which, under low magnification, recall fine fingerprints and run obliquely from the corners to the center. Median notal suture broad and shallow, consisting of a polished strip, bordered on each side by a deeper line; it shows sometimes a median reddish line and extends over the entire notum, but does not continue over the scutellum. Transverse mesonotal suture forming a very obtuse angle, opening forward; deep on the sides, superficial or effaced medially. Humeral callosities subconical, more or less grayish-ochraceous, with short black subterminal spines and near the middle a long dorsal bristle. Spiracle forming an indistinct notch on the lower outer side of the callosity. Lath-shaped side margins of prescutum with some black bristles; hind part of posthumeral callus forming a subconical protuberance bearing spines and one black bristle; directly behind this, the anteälar callus forms another protuberance without spines or bristles; hind margin of scutum on each side with a long bristle. Surface of scutellum either colored like the scutum or light-ochraceous, entirely or at the margins only; anterior margin somewhat convex; posterior margin truncate or slightly sloping medially, disclosing beneath it the metathorax and on the sides the squamular processes; margin of scutellum with a row of short and fine bristles. Under side of thorax ochraceous, with light reflexions. Abdomen generally dark colored, with scattered fine hairs and some larger postero-lateral bristles, usually 4 on each side. Legs light ochraceous-gray; knees and tips of tarsi darker; fore coxae shaped like large vesicular tubercles, with granulose surface, bearing sparse, short black hairs, which become longer on the under side. Median empodium large, curved and feathery; lateral empodia [pulvilli] half-moon-shaped, excavated. Claws black, with a long black tooth and an elongate, yellowish basal tubercle. Wings of the typical shape; yellow ground-color showing only in the axillary cell and in the anal cell over an area bordering the two-thirds away from the anal vein; the remainder infuscated through microscopic hairs, placed close together; large veins light chestnut." Although this description mentions few truly diagnostic characters, it applies well to *O. coriacea*. The size is particularly helpful, since *coriacea* is the only known small species in the genus. Moreover, I have studied at the U.S.N.M. a ♂, labelled *P. meleagridis* by Ad. Lutz and sent by him to the late J.M. Aldrich, from Pernambuco, taken on domestic turkey. This ♂, one of the original cotypes, agrees with what is called here *O. coriacea*.

3. Subfamily Melophaginae
Neolipoptena J. Bequaert, 1942

Neolipoptena J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 47 (monotypic for *Lipoptena ferrisi* J. Bequaert, 1935).

The only known species of *Neolipoptena* is restricted to western North America. The genus was described in detail in 1942.

Neolipoptena ferrisi (J. Bequaert)

Figs. 98*A–G*

Lipoptena subulata Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 187, figs. 2*C* and 4. Herms, 1950, Medical Entomology, 4th Ed., p. 412 (with *L. ferrisi* as synonym). Not of Coquillett, 1907.

Lipoptena ferrisi J. Bequaert, 1935, Bull. Brooklyn Ent. Soc., **30**, p. 170 (new name for *Lipoptena subulata* Ferris and Cole, 1922). Essig, 1942, College Entomology, p. 815.

Neolipoptena ferrisi J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 48, figs. 4*A–F* (with detailed bibliography and locality records). Herman, 1945, California Fish Game, **31**, pp. 17 and 20 (California: Ravendale and Susanville, Lassen Co., on *Antilocapra americana;* not the figures). Hare, 1945, Pan-Pacific Entom., **21**, p. 49 (California: Lake Co.; Ventura Co.). Cowan, 1946, Canad. Jl. Res., Ser. D, **24**, p. 77. Longhurst and Douglas, 1953, Trans. 18th North Amer. Wildlife Conf., pp. 177 and 184 (California: Hopland, Mendocino Co., on *Odocoileus hemionus columbianus*). Linsdale and Tomich, 1953, A Herd of Mule Deer, p. 230 (California: Hastings Reservation near Jamesburg, Monterey Co., on *O. h. columbianus*. Bionomics).

In addition to the generic characters mentioned in the key (Pt. II, p. 22), *N. ferrisi* differs from the 4 American species of *Lipoptena* in having from 15 to 20 setae on each inner orbit, some of these setae being placed above the eyes. The mid tibia has only one apical spur and the junction of costa and 3rd longitudinal vein is swollen and knob-like.

Distribution and Additional Records (since 1942). Dominion of Canada. British Columbia (recorded by Spencer, 1938, 1939; J. Bequaert, 1942): Pender I. (G.J. Spencer); Cobble Hill, on *Odocoileus hemionus columbianus* (I.McT. Cowan); Coxnox area, 100 miles N. of Nanaimo, Vancouver I., on *O. h. columbianus* (G.J. Spencer).

United States. California (recorded by Ferris and Cole, 1922, as *L. subulata;* J. Bequaert, 1942; Herman, 1945; Hare, 1945; Longhurst and Douglas, 1953; Linsdale and Tomich, 1953): Alturas, Modoc Co. (C. Griner); Redwood Creek, Humboldt Co., on *O. h. columbianus* (H.S. Barber); Hallelujah Junction, Lassen Co. (E.I. Schlinger); Ravendale, Lassen Co., 1 winged ♀ on *Antilocapra americana,* Sept. 18 (G.H. True, Jr.); Susanville,

Lassen Co., 1 ♀ and 1 ♂, both deälated, on head of *Antilocapra americana*, Sept. 13 (C.M. Herman); Dos Rios, Mendocino Co. (I.B. Tarshis); Black Diamond Mt., Glenn Co. (I.B. Tarshis); Wilbur Springs, Lake Co. (I.B. Tarshis); Nice, Lake Co. (A.W. Lindquist); Colusa, Colusa Co. (I.B. Tarshis); Truckee, Nevada Co., on *O. h. hemionus* (E.I. Schlinger); Pollock Pines, Eldorado Co. (A.T. McClay); Chino Flat, Eldorado Co. (L.W. Quate); Snowline, Eldorado Co. (J.S. MacSwain); Mill's Valley, Marin Co. (H.B. Leach); Marin Co., on *O. h. columbianus;* Mt. Diablo, Contra Costa Co. (F.X. Williams); Pinecrest, Tuolumne Co. (P.H. Arnaud, Jr.); Topaz Lake, Mono Co. (R. Coleman); Big Pine Creek, Inyo Co. (R.M. Bohart); Santa Barbara, Sa. Barbara Co.; Angelus Crest, Palmdale Highway, 4000 ft., Los Angeles Co. (W.A. McDonald); Tanbark Flat, Los Angeles Co. (W.A. McDonald); Cabazon, Riverside Co., on *O. h. californicus* (D.G. Hall); Palomar Mountain, San Diego Co., on *O. h. californicus;* Vandeventer Flat, San Jacinto Mts., Riverside Co. (E.G. Linsley); Cleveland National Forest, San Diego Co., on *O. h. californicus* (H. Owen); [previously recorded also from Tehama, Plumas, Mariposa, Madera, Monterey, Fresno, Tulare, Ventura, and San Bernardino Counties]. — Montana (recorded by J. Bequaert, 1942): Medicine Springs, Ravalli Co., on *O. h. hemionus* (W.J. Jellison and Sargent); White Sulphur Springs, Meagher Co., 110° W., on *O. h. hemionus,* Nov. (C.B. Philip); Snowy Mts. near Roundup, Ravalli Co., on *O. h. hemionus,* Oct. 25 (C.B. Philip). — Oregon (recorded by J. Bequaert, 1942): Curry Co.; 10 miles W. of Philomath, Benton Co. (V. Roth); Bly, Klamath Co., on *O. h. hemionus* (A. Walker). — South Dakota: Spearfish, Lawrence Co., on *O. h. hemionus,* Nov. 10 (P. Kohler); Black Hills, Lawrence or Pennington Co., about 103° 30′ W., on *O. v. leucurus,* Nov. (C.L. McGuigain). — Washington (State): Addy, Stevens Co., 10 deälated specimens, together with 2 *L. depressa,* on one *O. h. hemionus* (J. Hatter); La Grange, Goshen Co. (R.L. Furness); Elk, Teton Co. (R.L. Furness); Elbe, Pierce Co. (R.L. Furness); Winthrop, Okanagan Co., on *O. h. hemionus,* Oct. 12 (G.E. Quinby). — Wyoming (recorded by J. Bequaert, 1942): Sheridan, Sheridan Co., 107° W. (R. Cooper).

Mexico: La Laguna, Sierra Laguna, Baja California (E.S. Ross and R.M. Bohart).

N. ferrisi is restricted to western North America, where its known range covers southern British Columbia (northward to 51°), the State of Washington, Oregon, Wyoming, Montana, west-

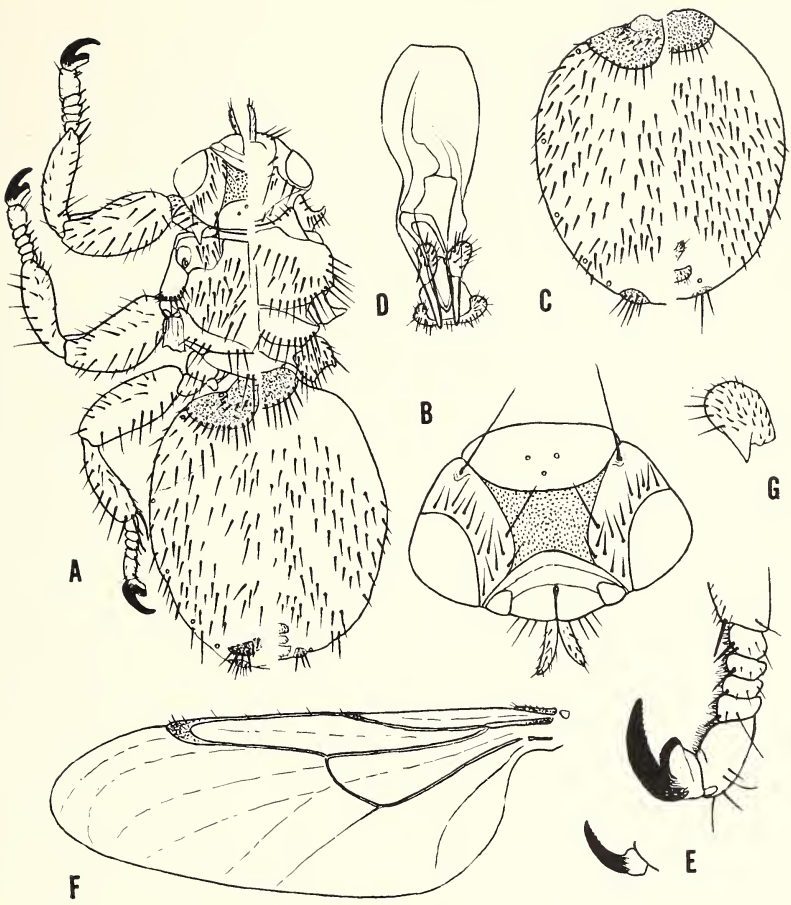

Fig. 98. *Neolipoptena ferrisi* (J. Bequaert), Palomar Mountain, California, on *Odocoileus hemionus californicus:* **A**, body dorsally and ventrally, ♀; **B**, head, ♀; **C**, abdomen dorsally and ventrally, ♂; **D**, ♂ terminalia; **E**, tarsus and claws (inner and outer) of fore leg, ♀; **F**, wing, ♀; **G**, fore coxa from above, ♀.

ern South Dakota, California and Lower California. The eastmost record is from South Dakota, near 103° 30′ W.

Bionomics. *N. ferrisi* is common on three of the races of *Odocoileus hemionus:* the Rocky Mountain mule deer, *O. h. hemionus,* the coastal black-tailed deer, *O. h. columbianus,* and the California black-tailed deer, *O. h. californicus.* The area covered by this ked practically coincides with that inhabited by *O. hemionus,* which I regard as its only true breeding host. In an earlier

paper (1942*a*, pp. 50–51) and in the present I list four records from the western white-tailed deer, *Odocoileus virginianus leucurus*, in Oregon, Montana, South Dakota and California; but I am inclined to regard these at best as accidental occurrences. I doubt that *N. ferrisi* could maintain itself in nature on white-tailed deer in the absence of *O. hemionus*. The species has recently been taken twice on prong-horn antelope, *Antilocapra americana*, a most interesting though presumably only a stray host. A stray specimen was also recorded from a quail, *Lophortyx californica*. Where it occurs, it is found together with *L. depressa*, though it is usually less abundant; but mixed infestations are not unusual. For instance, in a lot taken from a single deer at Pender Island, 291 were *depressa* and only 16 *ferrisi*. At the Hastings Reservation near Jamesburg, California, Linsdale and Tomich (1953, pp. 230–231) found that of 6,582 keds taken on 25 *O. h. columbianus* in 8 different months, 963, or 14.6 per cent, were *ferrisi*. The proportion of *ferrisi* was much lower among the volants captured in the open (0.5 per cent of 290 flies). Occasionally the two species were almost equally abundant on one host, a lot of 278 keds taken in August comprising 115, or 41.4 per cent, *Neolipoptena*. These authors were unable to detect differences in behavior or seasonal occurrence between the two species. Of 963 *ferrisi* taken on deer, 939 were found in July, August and September, and 22 in December; none occurred in January, May, October and November; September was the peak month.

Lipoptena Nitzsch, 1818

Hippobosca subg. *Lipoptena* Nitzsch, 1818, in Germar's Mag. der Entom., **3**, p. 310 (monotypic for *Hippobosca cervina* Nitzsch, 1818 = *Pediculus cervi* Linneaus, 1758).

Lipoptena J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 52 (full synonymy).

Additional synonyms not mentioned in 1942:

Lipoptenus Meinert, 1890, Entom. Meddel., Copenhagen, **2**, pt. 5, p. 216 (in the combination *Lipoptenus cervi;* error for *Lipoptena*).

Lypoptena Zavattari, 1928, Atti Soc. Italiana Sci. Nat., **67**, p. 43 (error for *Lipoptena*).

Lipopterna Wardle, 1936, General Entomology, p. 252 (error for *Lipoptena*).

Lipotina Cloudsley-Thompson, 1955, Science Progress, **43**, No. 172, p. 621 (error for *Lipoptena*).

The generic characters are given in my paper of 1942, where I divided the genus into 2 subgenera: *Lipoptena*, proper, containing most of the species, and *Lipoptenella* J. Bequaert, 1942. The number of apical spurs on the mid tibia can no longer be used as a subgeneric character, as *L. guimaraesi*, described below, has 3

apical spurs, while in every other character it is closely related to *L. depressa.*

Lipoptena is nearly world-wide in distribution, but is absent from Madagascar, Australia and New Zealand. I now recognize 15 valid species (including one undescribed from the Oriental Region), in addition to 3 doubtful forms. Of the 4 New World species, one (*L. cervi*) is a recent introduction by Man from the Old World and a *Lipoptena,* proper. The other 3 are autochthonous and precinctive, and belong in *Lipoptenella.* All 4 species agree in bearing relatively few setae on the inner orbits, none of the setae being found in the postero-lateral area above the eye. This peculiarity differentiates them from *Neolipoptena ferrisi* and is additional to the strictly generic characters mentioned in the key (Pt. II, p. 22).

In a further effort to dispel the persistent error that some of the *Lipoptena* use bats as normal or breeding hosts, I point out once more that all published records from such animals should be disregarded. In particular, the following names were based either on erroneous generic identifications or on unsubstantiated surmises of the host relations: *Lipoptena phyllostomatis* Perty (1833) was a streblid of the genus *Aspidoptera. Lipoptena pteropi* Denny (1843) was a true *Lipoptena,* to judge from the description and original figures; but the author's claim that he took it from "*Pteropus edulis*" must have been due to a confusion of labels or a faulty memory; no such fly has ever been seen among the many ectoparasites collected from this or any other East Indian bat during the past century. *Lipoptena dubia* Rudow (1871) was a streblid of the genus *Paradyschiria. Lipoptena tolisina* "Speiser", in Muir (1912), was an error for "*Listropoda tolisina*", one of the Nycteribiidae. Some of these names are discussed further in my Monograph of the Melophaginae (1942*a,* pp. 46 and 209–210). As for the supposed occurrences on birds, no doubt newly-emerged volants of *Lipoptena* may occasionally stray to them, as they will to Man or any moving object; but there is no reliable evidence that deer-keds ever attempt to bite birds or remain on them long enough to shed the wings (see J. Bequaert, 1942*a,* p. 75; the name of the European grouse given there as *Bonasa umbellus* should be corrected to *Tetrao urogallus*).

Key to American Species of *Lipoptena*

1. Median tergal plates of abdomen distributed over most of the length of the dorsum; 2nd basal pleurites (laterotergites)

broadly and briefly triangular, nearly trapezoidal. Apical spur of fore tibia stout, spine-like; mid tibia with 2 stout apical spurs. Wing with junction of costa and 3rd longitudinal vein simple, not knob-like ..... *L. cervi*

Median tergal plates of abdomen small, crowded near tip of dorsum (sometimes reduced to one); 2nd basal pleurites (laterotergites) elongate triangular. Wing (in *L. depressa* and *L. mazamae*) with junction of costa and 3rd longitudinal vein swollen, knob-like 2

2. Apical spur of fore tibia very thin, hair-like; mid tibia with one stout apical spur. Inner orbit with 3 to 6 setae, some very small. Disk of mesonotum on each side with a transverse group of setae connecting the median row of acrostichals with the mesopleurals (lateral prealar group). *L. depressa*

Apical spur of fore tibia stout, spine-like 3

3. Inner orbit with 1 or 2 setae. Disk of mesonotum extensively bare, the median row of acrostichals separated on each side by a bare area from the few setae placed near the mesopleurals. Mid tibia with one stout apical spur. *L. mazamae*

Inner orbit with 3 or 4 long setae. Disk of mesonotum on each side with a transverse group of setae connecting the median row of acrostichals with the mesopleurals. Mid tibia with 3 stout apical spurs, the median one long, the side ones much shorter ..... *L. guimaraesi*

Subgenus *Lipoptena*, proper

Lipoptena cervi (Linnaeus)
Figs. 13*B* and 99*A–G*

Pediculus cervi Linnaeus, 1758, Syst. Nat., 10th Ed., 1, p. 611 (in part; no sex; "in *Cervo elapho, dama, capreolo*"; without description, but with several references, including one to a figure of the deer-ked by Frisch, 1736; no locality, but evidently from Europe).[63]

[63] As pointed out in 1942, Linnaeus based his *Pediculus cervi* of 1758 on references to published figures only and it is doubtful that he ever saw specimens. Dr. F. Bryk recently (June, 1950) wrote me that there are no Linnaean specimens of *L. cervi* in any Swedish collection. The deer-ked occurs, however, in southern Sweden, where it was first definitely recorded by Zetterstedt (1848). When Linnaeus included *Pediculus cervi* in the 2nd Edition of his Fauna Suecica (1761, p. 71), he restricted the name to Frisch's

Lipoptena cervi J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 58, figs. 5*A–G* (with detailed bibliography and records). Bump, 1941, **30th** Ann. Rept. New York State Conserv. Dept., (for 1940), p. 224 (New York State). Webber, 1950, in Craighead, Insect Enemies Eastern Forests, U.S. Dept. Agric. Misc. Publ. No. **657**, (for 1949), p. 529. Kettle and Utsi, 1955, Parasitology, **45**, Nos. 1–2, p. 119 (in Scotland, infesting imported reindeer).

Haemobora pallipes Curtis, 1824, British Entomology, **8**, Pl. 14 (first printing, with letterpress; plate dated March 1, 1824. ♂; on Man. New Forest, England); 1834, *Op. cit.*, **8**, Pl. 14 (second printing, with altered letterpress); 1829, Guide Arrangement British Insects, column 242; 1837, *Op. cit.*, 2nd Ed., column 278. Stephens, 1829, Syst. Cat. Brit. Ins., **2**, p. 327. Walker, 1853, Insecta Britannica, Dipt., **2**, p. 288; Pl. 20, fig. 4. White, 1854, List Spec. Brit. Anim. Brit. Mus., **15**, p. 41. Wood, 1872, Insects at Home, p. 643, cut LXXVIII, figs. 1 and 1*a–c*. Blackwelder, 1947, Smithson. Misc. Coll., **107**, No. 5, pp. 22 and 23 (facsimile reproductions of 1st and 2nd printings of Curtis' text).[64]

Ornithobia pallida ["M." Curtis, 1829, Guide Arrangement British Insects, column 242; *nomen nudum*]. Meigen, 1830, Syst. Beschreib. Europ. Zweifl. Ins., **6**, p. 230; Pl. 63, figs. 21–24 (no sex; no host; Germany. Type lost). Curtis, 1837, Guide Arrangement British Insects, 2nd Ed., column 278. Theobald, 1896, Parasitic Diseases Poultry, pp. 34 and 35, fig. 10 (supposed occurrence on fowls; an unreliable record).

Lipoptena subulata Coquillett, 1907, Ent. News, **18**. p. 290 (♀ ♂; on deer. New Hampshire: Woodstock. Holotype ♀, No. 10292, and 5 paratypes (4 ♀, 2 on a slide, and 1 ♂) at U.S.Nat.Mus.). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303.

References to other European synonyms, *Ornithomyia nigrirostris* v. Roser (1840), *Lipoptena alcis* Schnabl (1881) and *Lipoptena cervi* var. *obscura* Lühe (1906), in my Monograph (1942*a*). The erroneous South American references to *L. cervi*, based on specimens of *L. mazamae*, are listed under that species.

Distribution in America and Additional Records (since 1942). United States. Massachusetts (recorded by Johnson, 1925, as *L. subulata;* J. Bequaert, 1942). — New Hampshire (recorded by Coquillett, 1907, as *L. subulata;* Johnson, 1925, as *L. subulata;* J. Bequaert, 1942): Corbin Park near Newport, Sullivan Co., on *Cervus canadensis* in captivity, Nov. 2, 1942 (R.C. Morrill); Croydon, Blue Mt. Forest, Sullivan Co., on heavily infested *Odocoileus virginianus borealis*, Dec. 29, 1950 (R.G. Carpenter). — New York (recorded by Gerberg and Goble, 1941; J. Bequaert,

figure, but without a word of description, further proof it would seem that he never saw a specimen.

[64] These references should replace those given for *H. pallipes* in my Monograph (1942*a*, p. 65), which are incomplete and misleading. I was not aware at the time of the two printings of Curtis' original description. The text I quoted (1942*a*, p. 78) was from the second printing, that of the first printing being copied below.

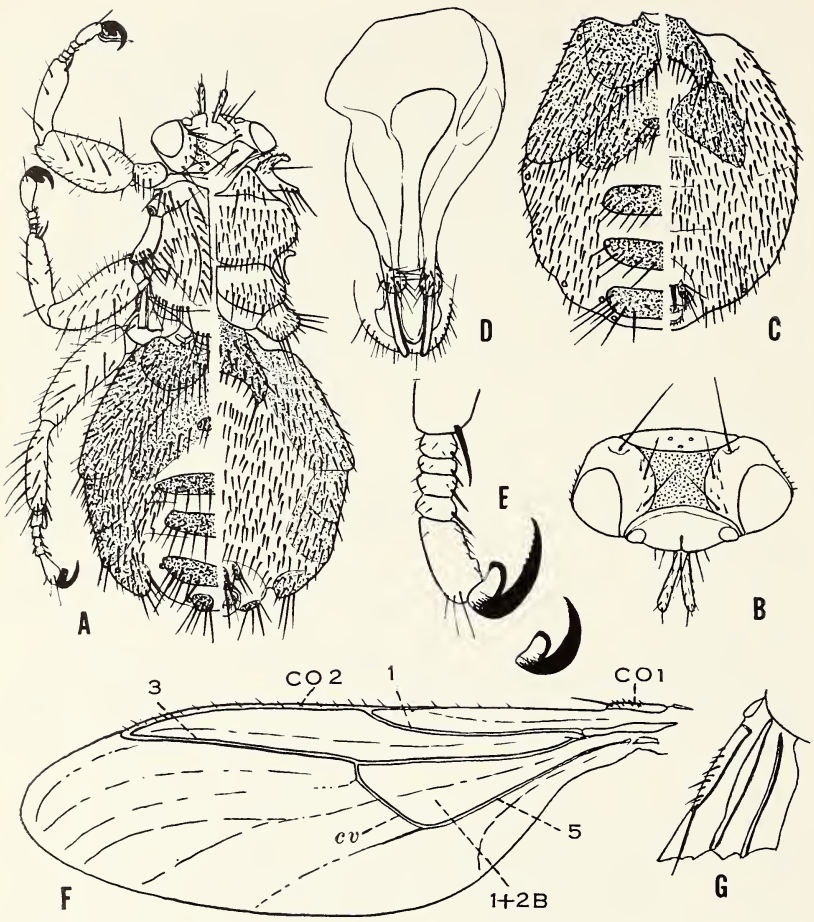

Fig. 99. *Lipoptena cervi* (Linnaeus). **A**, body dorsally and ventrally, ♀, Woodstock, New Hampshire, on deer (paratype of *L. subulata* Coquillett); **B**, head, ♂, Recey-sur-Ource, France, on *Capreolus capreolus;* **C**, abdomen dorsally and ventrally, ♂, same data; **D**, ♂ terminalia, same data; **E**, tarsus and claws (inner and outer) of fore leg, ♂, same data; **F**, wing of volant ♂, Parcé, France: *1, 3* and *5*, 1st, 3rd and 5th longitudinal veins; *1+2B*, combined 1st and 2nd basal cells; *CO1* and *CO2*, basal and apical sections of costa; *cv*, combined anterior and anterior basal cross-veins; **G**, basal stump of wing, deälated ♀, Woodstock.

1942): on dead deer brought to Albany, Albany Co., Nov. 18, 1938 (A. Paladin); W. side of Racquet Lake, Long Lake, Hamilton Co., on *O. v. borealis,* Nov. 7–9, 1954 (J. Heller); Allegany Park, Cattaraugus Co., on *O. v. borealis,* Nov. 13, 1949 (W.J. Hamilton, Jr.). — PENNSYLVANIA (recorded by J. Bequaert, 1942): McKean

Co., Dec. 1953 (H. Groves); Cameron Co., Dec. 1953 (H. Groves); [said to occur commonly in Cameron Co. on deer and wapiti].

L. cervi is an Old World species introduced accidentally by Man into the northeastern United States some time prior to 1907. It is now well established on native hosts in New Hampshire, Massachusetts, New York and Pennsylvania. It is widely distributed in the Palearctic Region, from the British Isles (including Ireland) to eastern Siberia and northern China, northward to southern Sweden and Esthonia, southward to Algeria.

In my Monograph (1942*a*, p. 71) I discussed the published records of *L. cervi* from outside the Palearctic and Nearctic Regions, concluding that all were based on misidentifications. I did not include Hennig's (1941*a*, p. 177) record from Formosa (Chip Chip), based on an identification by Schuurmans Stekhoven, which may or may not be correct.

In the eastern United States *L. cervi* has been taken thus far on northern Virginia deer, *Odocoileus virginianus borealis*, and on wapiti, *Cervus canadensis*. The host relations and life-history were fully treated in my Monograph (1942*a*, pp. 71–76) and there are references in Part I to the following topics: symbiotic microorganisms (p. 103), mechanism of feeding (p. 109), frequency of meals (p. 113), sex ratio (p. 177), larviposition (p. 186), abnormal hosts (pp. 217–218), location of hosts (p. 221), population dynamics (p. 228), acquisition of new hosts (p. 246), host relations (pp. 288 and 319), and attacks upon Man (pp. 339–340). With regard to the ease with which *L. cervi* has adopted American wild deer as new hosts, the following recent occurrence is of some interest. As part of an attempt to introduce the northern European reindeer, *Rangifer tarandus*, from Lapland to the Highlands of Scotland, some of these animals are now kept under close supervision near Rothiemurchus, Inverness-shire, particular attention being paid to their parasites. According to Kettle and Utsi (1955), a few months after the arrival of the animals they were found to be heavily infested with the native British deer-ked, *Lipoptena cervi*, specimens of which were sent to me by Dr. D.S. Kettle. It is particularly noteworthy in this connection that deer-keds have never been recorded from reindeer in their natural Old World range, nor from its North American representative, the caribou.

The only description and figure of the puparium of *L. cervi* I was able to trace, are by Eleanor Ormerod (1898, as *Lipoptera cervi*), reproduced later by Wallace (1904).

Original description of *Haemobora pallipes* Curtis (first printing, 1824):

"Shining, with strong hairs scattered over the limbs and body; pale and dull; greenish-yellow clouded with brown. Eyes and claws black. Thorax beneath punctured and covered with short, strong erect hairs. Wings nearly transparent, nerves yellow, the costa slightly ciliated." Additional specific characters are contained in the generic diagnosis: "Antennae inserted close to the anterior angles of the clypeus, globular, hairy, and sunk into the head. Labrum horny, elongate, hollow, slightly arcuated, inclosing the tongue. Tongue nearly as long as labrum, slender. Lip horny, arched, hollow, inclosing the labrum and tongue. Maxillae? rigid, obtuse, ciliated with strong hairs, united at their internal edges, bent downwards, inclosing the proboscis, and extending beyond the head like a beak. Mentum large, coriaceous, membranaceous, covering and concealing the base of proboscis. Ocelli 3, in a triangle, sunk in foveolae. Wings very long, rounded, first marginal or mediastinal cell extending one-third the length of the wing; second marginal cell very long, rounded at the end, discoidal cells united, 6 obscure, imperfect nerves extending to posterior margin. Tarsi 5-jointed, last the longest; Claws, lengthened at their base on each side the pulvillus. Head broader than long, somewhat triangular, divided from the thorax. Eyes very remote, small. Thorax a little broader than head, nearly quadrate, dilated near the base of wings, notched anteriorly. Scutellum broad and short. Halteres very distinct. Abdomen small, nearly conical, pedunculed, coriaceous towards its base, the remainder spongy. Feet extended, thick, first pair remote from the wings, inserted almost under the head." A comparison of these quotations with those of the second printing, given in my Monograph (1942*a*, pp. 78–79), shows that the differences are trivial. I have not copied the statements relative to larva and pupa in the first printing (omitted in the second printing), because they were taken from Latreille and do not refer specifically to *Haemobora*.

Subgenus *Lipoptenella* J. Bequaert, 1942

Lipoptena subg. *Lipoptenella* J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, pp. 47, 55 and 118 (type by original designation: *Melophagus depressus*, Say, 1823).

Lipoptena (*Lipoptenella*) *depressa* (Say)
Figs. 11*A–B* and 100*A–F*

Melophagus depressus Say, 1823, Jl. Ac. Nat. Sci. Philadelphia, **3**, p. 104 (no sex; on "*Cervus virginianus*" [= *Odocoileus virginianus*]. North America, without precise locality; possibly from Colorado. Type lost).

Lipoptena depressa J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 118, figs., 1*E–F* and 11*A–F* (with full bibliography and locality records).

The following references were not mentioned in 1942.

Lipoptena depressa Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 303. Herms, 1915, Medical Veterinary Entomology, p. 295, fig. 186; 1923, *Op. cit.*, 2nd Ed., p. 350, fig. 187. Craig, 1923, in Wooldridge, Encyclopaedia Veterinary Medicine, **1**, Veter. Med., p. 500. J.H. Comstock, 1924, Introduction to Entomology, p. 875 (also in 1940 printing, p. 875). Essig, 1942, College Entomology, p. 815. Cowan, 1943, Canad. Jl. Res., Ser. D, **21**, pp. 180–186 (British Columbia: southern Vancouver I. Life-history). Steinhaus, 1943, Jl. of Parasitology, **29**, p. 80 (Montana: Hamilton. Rod-like bacteria in intestinal tract). Herman, 1945, California Fish Game, **31**, p. 17. Hare, 1945, Pan-Pacific Entom., **21**, pp. 48–57 (bionomics of volants. California: Binkley Ranch near Kelseyville, Lake Co.; 17-mile Drive, Carmel, Monterey Co.; Sespe Gorge near Ojai, Ventura Co.; Mt. Diablo,

Contra Costa Co.; Redwood and Strawberry Canyons, Alameda Co.); 1945, Summary of Dissertation, Berkeley, Calif., p. 1. Cowan, 1946, Canad. Jl. Res., Ser. D, **24**, p. 77. Steinhaus, 1946, Insect Microbiology, pp. 44, 206, and 245, fig. 15 (infection with an intracellular bacterium, *Corynebacterium lipoptenae* Steinhaus). Shaw, 1947, Oregon Agric. Expt. Sta., Techn. Bull. **11**, p. 5 (Oregon).[65] Florenzano, 1949, Redia, Florence, (2), **34**, p. 143 (*Corynebacterium lipoptenae*). Herms, 1950, Medical Entomology, 4th Ed., p. 412, fig. 137. Holdenried, Evans and Longanecker, 1951, Ecological Monographs, **21**, pp. 11 and 14 (California: Calaveras Dam, Alameda Co., on *Odocoileus hemionus columbianus*). Hennig, 1952, Larvenformen der Dipteren, **3**, p. 402. Hare, 1953, Microentomology, **18**, pt. 2, pp. 38–51, figs. 16–18 (California: Carmel; Mt. Diablo; Strawberry Canyon. Bionomics). Longhurst and Douglas, 1953, Trans. **18th** North Amer. Wildlife Conf., pp. 177 and 184 (California: Hopland, Mendocino Co., on *O. h. columbianus*). Linsdale and Tomich, 1953, A Herd of Mule Deer, pp. 230–236 (California: Hastings Reservation near Jamesburg, Monterey Co., on *O. h. columbianus*. Bionomics).

Lipoptera depressa Zebrowski, 1932, Audubon Year Book, Indiana Audubon Soc., p. 48.

Neolipoptena ferrisi Herman, 1945, California Fish Game, **31**, p. 17, figs. 9*A–C* (♀, volant, puparia). Not of J. Bequaert, 1935.

Distribution and Additional Records (since 1942). Dominion of Canada. British Columbia (recorded by Ferris and Cole, 1922; Spencer, 1938, 1939; J. Bequaert, 1942): Hardy I., on *Odocoileus hemionus columbianus* (G.J. Spencer); Wellington (R. Guppy); Robson (H.R. Foxlee); Duncan, Vancouver I., on *O. h. columbianus* (G.J. Spencer); Cobble Hill, on *O. h. columbianus* (I.McT. Cowan); Coxnox [not "Comox," as in 1942], 100 miles N. of Nanaimo, Vancouver I., on *O. h. columbianus* (G.J. Spencer); Vernon, on *Odocoileus h. hemionus* (S. Peters); Goldstream Lake, on *O. h. columbianus;* Crofton, on *O. h. columbianus* (I.McT. Cowan); Victoria, on *O. h. columbianus;* Cowishan, Vancouver I., on *O. h. columbianus* (G.C. Carl); Mt. Lehman, on *Odocoileus virginianus leucurus* (received from G.B. Thompson); Kotenay, on *O. v. leucurus* (G.J. Spencer); Pender I. (G.J. Spencer).

United States. California (recorded by Coquillett, 1907; Clarke, 1913; Ferris and Cole, 1922; O'Roke, 1936; J. Bequaert, 1942; Hare, 1945, 1953; Holdenried, Evans and Longanecker, 1951; Longhurst and Douglas, 1953; Linsdale and Tomich, 1953): Alturas, Modoc Co. (C. Griner); Redwood Creek, Humboldt Co., on *O. h. columbianus* (H.S. Barber); Hat Creek, Shasta Co. (R.L. Hall); Buchnell Creek, Mendocino Co. (K. Hagen); Hopland, Mendocino Co., on *O. h. columbianus* (W.M. Longhurst); Dos Rios,

[65] The reference in my Monograph of the Melophaginae to Shaw, Dixon and Huth, 1934, should be corrected to: Shaw, Simms and Muth, 1934, Oregon Agric. Expt. Sta., Station Bull. **322**, p. 21.

Mendocino Co. (I.B. Tarshis); Rancheria Creek near Boonville, Mendocino Co. (C.I. Smith); Wilson Lake, Tehama Co., on *O. h. columbianus* (Bischoff, Rosen and Tegen); Red Bluff, Tehama Co., on *O. h. columbianus* (J.J. du Bois and B. White); Palegreen's Place, Tehama Co., on *O. h. columbianus* (I.B. Tarshis); Paynes Creek, Tehama Co. (P. Oman); Quincy, Plumas Co., on *O. hemionus* (E.W. Jameson, Jr.); Seneca, Plumas Co., on *O. h. columbianus* (H.S. Barber); Black Diamond Canyon, Glenn Co. (I.B. Tarshis); Dasman Land, South Fork, Scott Creek, Cow Mt., Lake Co., on *O. h. hemionus* (J. Azevedo); Nice, Lake Co. (A.W. Lindquist); Truckee, Nevada Co., on *O. h. hemionus* (E.I. Schlinger); Santa Rosa, Sonoma Co. (K. Frick); Green Valley, Sonoma Co. (J.E. Gillaspy); Petrified Forest, Sonoma Co. (R.M. Bohart); Yountville, Napa Co., on *O. h. columbianus* (O. Brunetti); Hills above Capay, Yolo Co., emerged from puparium found in grass stem, Sept. 28; Pyramid Ranger Station, Eldorado Co. (J.W. MacSwain); Snowline Camp, Eldorado Co. (J.W. MacSwain); Pleasant Valley, Eldorado Co., volant, Oct. 7 (W.L. Nutting); River Pine, Amador Co., volant, Nov. (C.P. Felmley); Mt. Tamalpais, Marin Co. (Norland); Marin Co., on *O. h. columbianus;* Inverness, Marin Co., one volant on *Sitta pygmaea,* Sept. 5 (R.A. Norris); Mt. Diablo, Contra Costa Co. (E.I. Schlinger); Orinda, Contra Costa Co. (E.C. Clark); San Pablo Dam, Orinda, Contra Costa Co., one volant on *Lophortyx c. californica,* Oct. 13 (I.B. Tarshis) and one volant on *Accipiter striatus velox,* Nov. 3 (A. Hightower); Pinecrest, Tuolumne Co. (P.H. Arnaud); hills back of Oakland, Alameda Co. (J.E. Gillaspy); Strawberry Canyon, Berkeley, Alameda Co. (J.W. MacSwain); Sierral, Alameda Co., one volant on *Bubo virginianus pacificus* (I.B. Tarshis); Tildon Park, Berkeley, Alameda Co., on *O. h. columbianus* (I.B. Tarshis); Miami, Mariposa Co., on *O. h. hemionus* (Cope); Yosemite National Park, 3880–4000 ft., on *O. h. hemionus* (R.H. Smith); Big Trees Park, Santa Cruz, Sa. Cruz Co. (S.J. Carpenter and A.F. Archer); Ben Lomond, Sa. Cruz Co. (P.H. Arnaud); Felton, Sa. Cruz Co. (E.I. Schlinger); Del Monte Forest, 1½ miles S. of Pacific Grove, Monterey Co. (A.F. Archer); Arroyo Seco River, Monterey Co. (L.W. Hepner); Hastings Reservation near Jamesburg, Monterey Co., on *O. h. hemionus* (J.M. Linsdale); Carmel, Monterey Co. (N.E. Good); Pinnacles National Monument, San Benito Co. (J.W. MacSwain); Hollister, San Benito Co. (E.I. Schlinger); Dinkey Creek, Fresno Co. (C.K. Fisher); Huntington Lake, Fresno Co. (A.T. McClay); Florence Lake, Fresno Co., 7500 ft (E.I. Schlinger);

Hospital Rock and Ash Mt., Sequoia National Park, Tulare Co. (P. Oman; R.C. Bechtel; A.T. McClay); Big Pine Creek, Inyo Co. (R.M. Bohart); Kern Co. (E.A. McGregor); Santa Maria Valley, Sa. Barbara Co. (D.J. and I.N. Krull); Altadena, Los Angeles Co. (K.W. Cooper); Mt. Wilson Trail near Pasadena, Los Angeles Co. (K.W. Cooper; W.A. McDonald); Griffith Park, Los Angeles; Lake Elizabeth Canyon, Los Angeles Co. (J.N. Belkin); Westwood Hills, Los Angeles Co. (J.N. Belkin); Arcadia, Los Angeles Co. (K.W. Cooper); Tanbark Flat, Los Angeles Co. (F.X. Williams; J.K. Hester); Glendale, Los Angeles Co. (E.I. Schlinger); Big Dalton Dam, Los Angeles Co. (A.A. Grigarick); Sa. Catalina Is., Los Angeles Co. (W.J. Jellison and Welsh); Camp Baldy, San Bernardino Co. (A.T. McClay); Forest Home, San Bernardino Co., volants, Apr. 23 (V.E. Grant and R.K. Benjamin); Fullerton, Orange Co. (J.W. Hinerman); Marion Mtn. Camp, San Jacinto Mts., Riverside Co. (W.V. Garner); Keen Camp, Riverside Co. (E.I. Schlinger); Glen Ivy Hot Spring, Riverside Co.; Idyllwild, San Jacinto Mts., Riverside Co. (R. Husbands); Cabazon, Riverside Co., on *O. h. californicus* (D.G. Hall); Cleveland National Forest, San Diego Co., on *O. h. californicus* (H. Owen); Banner, San Diego Co. (W.W. Wirth); Escondido, San Diego Co. (G.S. Hull); [recorded in 1942 also from Trinity, Lassen, Calaveras, San Luis Obispo, and Ventura Counties]. — Idaho (recorded by J. Bequaert, 1942): Coeur d'Alene National Forest, Shoshone Co., on *O. v. leucurus* (O. Callis); Moscow Mt., Latah Co. (F.C. Zwickel); Laird Park, 8 miles from Harvard, Latah Co., volant, Oct. 3 (L. Yates). — Montana (recorded by J. Bequaert, 1942; Steinhaus, 1943): White Sulphur Springs, Meagher Co., on *O. h. hemionus* (C.B. Philip); Lincoln Co., on *O. v. leucurus* (L. Adams); U.S. Bison Range, Moiese, Lake Co., on *O. v. leucurus;* Florence, Ravalli Co. (F.C. Bishopp); Lolo, Missoula Co. (F.C. Bishopp); Lincoln, Lewis and Clark Co., on *O. v. leucurus*, Nov. (C.B. Philip); Missoula Co., on *O. v. leucurus* (Tibbs; T. Smith); Shook Mt., 6500 ft., Ravalli Co., volant on Man, Oct. 25 (Betty Locker). — Oregon (recorded by Shaw, Simms, and Muth, 1934; J. Bequaert, 1942; Shaw, 1947): Corvallis, Benton Co., on *O. h. columbianus* (A.W. Lindquist and E.F. Knipling); Diamond Lake, Douglas Co. (V. Roth); 10 miles N.W. of Baker, Baker Co. (V. Roth); Curlew, Ferry Co., Oct. 25 (H.I. Buechner); Cottonwood Canyon, Blue Mts., Asotin Co., on *O. h. hemionus,* Oct. 25 (H.K. Buechner); Devils Ridge, Blue Mts., Asotin Co., Oct. 17. — South Dakota (recorded by J. Bequaert, 1942): 2 miles W. of

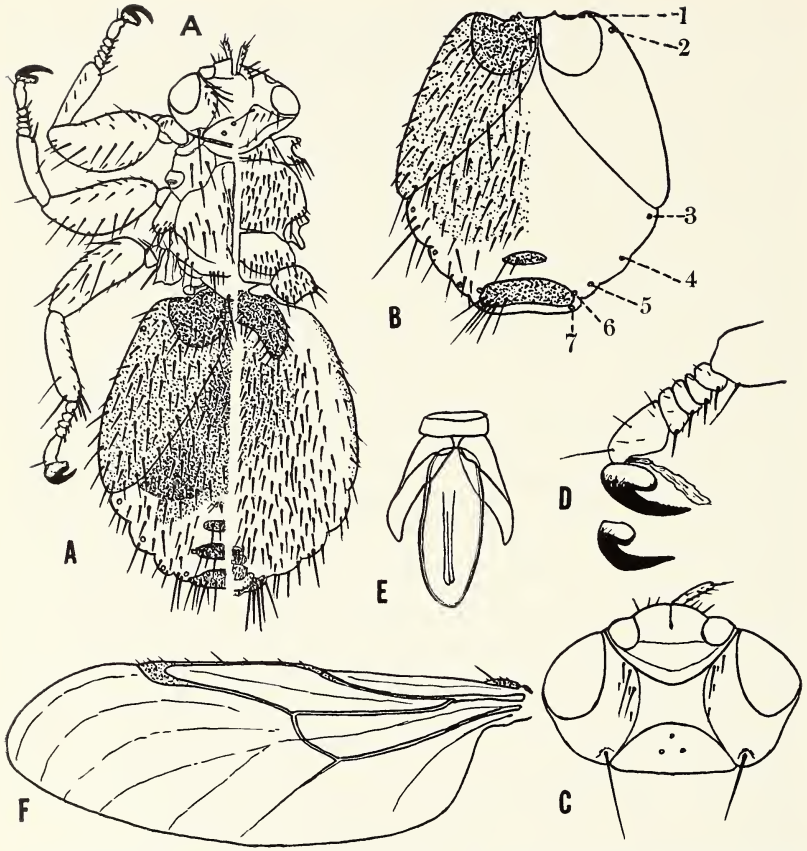

Fig. 100. *Lipoptena depressa* (Say). **A**, body dorsally and ventrally, ♀, Palomar Mountain, California, on *Odocoileus hemionus californicus;* **B**, abdomen dorsally and ventrally, ♂, Howe Sound, British Columbia, on *O. h. hemionus;* abdominal spiracles numbered 1 to 7; **C**, head, ♀, Palomar Mountain; **D**, tarsus and claws (inner and outer) of fore leg, ♀, same data; **E**, ♂ terminalia from above; **F**, wing of volant ♂, Sequoia National Park, California.

Rapid City, Pennington Co., June 17, on *O. h. hemionus* (L.M. Berner); Hot Springs, Fall River Co., on *O. v. leucurus* (H.C. Severin); Sylvan Lake, northern part of Custer Co., on *O. v. leucurus* (H.C. Severin); Spearfish, Lawrence Co., on *O. h. hemionus*, Nov. 10 (P. Kohler). — WASHINGTON (STATE) (recorded by Hatch, 1938; J. Bequaert, 1942): Spokane, Spokane Co. (D.E. Hardy); Mt. Constitution, Olga I., Puget Sound (A.C. Brown); Pullman, Whitman Co., volant, Sept. 17 (Helen James); Matlock,

Mason Co.; Ruby, Pend Oreille Co., on *O. v. leucurus;* Addy, Stevens Co., on *O. h. hemionus* (J. Hatter); Colville, Stevens Co. (C.O. Chollet). — Wyoming: Greybull, Big Horn Co., on *O. h. hemionus* (W.V. Cochran).

L. depressa is restricted to western North America, where it is known at present along the Pacific Coast from southern British Columbia (south of 50° N.) to southern California (San Diego Co., about 33° N.) and as far inland as the Black Hills of western South Dakota (about 103° 30′ W.). It occurs no doubt also in some of the Rocky Mountain states and provinces not listed above. It should be looked for particularly in Colorado, where no deer-keds have been recorded, although this is the area where Say most probably collected the type specimens.

Deer-keds seem to be absent from Arizona and New Mexico, although deer are fairly common there in certain sections. According to Dr. A.R. Mead (*in litt.*, 1953), Mr. Paul Illig examined some 300 deer in the area north of Phoenix, but failed to find any keds, although he is well acquainted with these parasites. The matter should be investigated further, as some adverse climatic factor may be involved.

Bionomics. *L. depressa* is the usual and common parasite of several races of *Odocoileus hemionus*, the Rocky Mountain mule deer, *O. h. hemionus*, the coastal black-tailed deer, *O. h. columbianus*, the California black-tailed deer, *O. h. californicus*, and probably also the southern black-tailed deer, *O. h. fuliginatus* (volants taken in San Diego Co.); as well as of the western white-tailed deer, *Odocoileus virginianus leucurus*. Both species are equally efficient breeding hosts. There is one stray record from American elk or wapiti, *Cervus canadensis*. The volants, or newly-emerged winged keds, often appear in large numbers at the proper season, particularly in spring and fall, and fly onto any moving object, thus reaching Man and horses on which they alight for a short time, but scarcely ever attempt to feed. Most of the records listed above without hosts are based on such volants. The winged keds may also stray to wild birds, which explains the accidental occurrences on California valley quail, great horned owl, sharp-shinned hawk, and pygmy nuthatch.

In my 1942 Monograph (pp. 123–124) I discussed the bionomics of *L. depressa* and in Part I of the present work I mentioned briefly the following items: bacteria in the gut (pp. 101 and 132), resistance to starvation (pp. 114–115), distribution on the host's body (p. 125), tropisms (p. 128), sex ratio (p. 177), mating (pp.

181–182), larviposition (p. 186), formation of puparium (p. 196), duration of pupal development (p. 198), adult longevity (p. 203), rate of reproduction (p. 207), population dynamics (p. 228), and host relations (p. 317). Particular attention is now called to two important recent publications by Hare (1953) and by Linsdale and Tomich (1953). Hare followed adult keds on deer in captivity from the volant stage throughout life. Linsdale and Tomich studied the population dynamics and behavior of the keds in the Hastings Reservation, Monterey Co., California, a natural undisturbed area well stocked with black-tailed deer, which often showed mixed infestations of *L. depressa* and *N. ferrisi* (see under that species). Of 6,582 keds taken on 25 deer in 8 different months, 5,619, or 85.4 per cent, were *depressa*. This species occurred on the host in all 8 months, but mostly in July (849), August (986) and September (the peak month, with 3,437 keds). The keds were few in January (13), May (9), October (64), November (4) and December (204). The largest individual infestation consisting only of *L. depressa* numbered 64, and the heaviest of both *L. depressa* and *N. ferrisi* was on a buck carrying 3,493 keds. The authors also made many observations on the volants in the same area: few flies were on the wing through the winter; they became more abundant in April and May and were at their peak in August, September and October. In late fall they were particularly numerous in periods of warm weather. Although many were observed alighting on Man or horse, they were rarely seen attempting to bite a horse and never established themselves on this host. Most of the volants left quickly without dropping the wings. The authors note that the flies are apparently unable to survive or to transfer to a new host after losing the wings or in cold weather.

The puparium, figured by Hearle (1938) and Herman (1945, as *N. ferrisi*), was described in my Monograph (1942*a*, p. 124).

Say's original description of *Melophagus depressus* was copied in my Monograph (1942*a*, p. 124). I have attempted to define more precisely the section of Colorado where Say obtained his specimens. E. James' "*Account of the Expedition from Pittsburgh to the Rocky Mountains . . . under the Command of Major Stephen H. Long*" (2 Vols., Philadelphia, 1823) shows that deer were common and frequently killed by the party in the area of the Upper Arkansas River between the 102nd Meridian and Pike's Peak (near 105° W.). In Vol. 2 there are frequent references (pp. 34, 40, 49, 63, 70, 75, 84, and 88) to western white-tailed deer, now called *Odocoileus virginianus leucurus*, and black-tailed or mule

deer, now called *O. h. hemionus*. Say described the latter anew as *Cervus macrotis* (Vol. 2, p. 88, footnote) from a skin obtained in this area. As *L. depressa* is found on both kinds, he had plenty of opportunity to collect it. This ked should therefore be looked for in southeastern Colorado, preferably in El Paso and Pueblo Counties, on whatever deer may remain there.

Lipoptena (*Lipoptenella*) *mazamae* Rondani
Figs. 101*A–D*

The following references are mostly supplementary to my 1942 Monograph.

Lipoptena mazamae Rondani, 1878, Ann. Mus. Civ. Stor. Nat. Genova, **12**, p. 153 (♀. Central and South America, without precise locality; on "*Cervus mexicanus*" [=*Odocoileus virginianus mexicanus*]. Type collected by Bellardi, hence it came most probably from Mexico; presumably lost). Vogelsang, 1940, Rev. Med. Veter. Paras., Caracas, **2**, Nos. 3–4, p. 37 (Venezuela: Barbula, State Carabobo, on cattle). J. Bequaert, 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 80. Van Volkenberg and Nicholson, 1943, Jl. Wildlife Manag., **7**, p. 222 (Texas: Comal Co., on deer). Guimarães, 1944, Papéis Avulsos Depto. Zool., São Paulo, **6**, No. 16, p. 184, figs. 3, 3*a*, 4 (Brazil: Porto Cabral, State São Paulo, on *Mazama americana*. Puparium). Anduze, Pifano and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Reyes, 1947, Rev. Grancolombiana Zoot. Hig. Med. Vet., Caracas, **1**, Nos. 10–12, p. 707 (Colombia: Rio Negro, Santander, on deer); 1948, Rev. Med. Vet., Bogotá, **17**, No. 96, p. 71. Vogelsang, 1948, Rev. Med. Veter. Paras., Caracas, **7**, Nos. 1–4, p. 146. Eads, 1949, Jl. Econ. Entom., **42**, p. 158 (Texas: New Braunfels, on cattle). Renjifo-Salcedo, 1950, An. Soc. Biol., Bogotá, **4**, pt. 1, p. 5 (Colombia). de Buen, 1950, An. Inst. Biología, México, **21**, pt. 2, p. 245 (Mexico: Majahuita, 1 Kilom. W. of Zihuatanejo, State Guerrero, on "*Odocoileus virginianus acapulcensis*" [=*O. v. mexicanus*]). Gallo and Vogelsang, 1951, Rev. Veter. Paras., Caracas, **10**, Nos. 1–4, p. 35 (Venezuela: on *Odocoileus* and cattle). Hennig, 1952, Larvenformen der Dipteren, **3**, p. 403.

Lipoptena (*Lipoptenella*) *mazamae* J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 126, figs. 12*A–C* (with detailed bibliography and locality records); 1943, Jl. of Parasitology, **25**, p. 131.

Lipoptena mazani Vogelsang, 1953, Deutsch. Tierärztl. Wochenschr., **60**, p. 530 (Venezuela: on cattle in the Llanos; error for *mazamae*).

Lipoptena depressa var. *mexicana* Townsend, 1897, Ann. Mag. Nat. Hist., (6), **20**, p. 289 (♀ ♂. Mexico: Paso de Telaya, State Vera Cruz, on *Odocoileus virginianus mexicanus*. Cotypes at Brit. Mus.). Speiser, 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Lipoptena conifera Speiser, 1905, Zeitschr. Syst. Hym. Dipt., **5**, p. 354 (♀ ♂. Brazil: on *Mazama simplicicornis*. Types probably lost); 1908, Zeitschr. Wiss. Insektenbiol., **4**, p. 304.

Lipoptena surinamensis Bau, 1930, Stettin. Ent. Zeitg., **91**, pt. 2, p. 175 (♀ ♂; no host. Surinam: Paramaribo [misspelled "Macaraibo"]. Types formerly at Hamburg Mus., now lost; paratypes at Stanford Univ. Mus.).

Lipoptena cervi Fiasson, 1943, Rev. Sci. Méd. Pharm. Vétér. Afrique Française Libre, **2**, p. 148 (Venezuela: Upper Apure region, on *Odocoileus virginianus gymnotis*); 1945, Cahiers de l'Institut Français Amér. Latine, Mexico, **3**, p. 26 (Venezuela: Upper Apure region, on

Odocoileus virginianus gymnotis. I have seen some of these specimens). Corrêa, 1952, Bol. Dir. Prod. Anim., Rio Grande do Sul, **8**, No. 13, p. 3; Pl., fig. 1 (Brazil: São-José-del-Norte, State Rio Grande do Sul, on "veado comun"). Not of Linnaeus, 1758.

Melophagus ovinus Randolph and Eads, 1947, Ann. Ent. Soc. America, **39**, (for 1946), pt. 4, p. 600 (Texas: Lavaca Co., on *Odocoileus v. virginianus*). Not of Linnaeus, 1758.

Distribution and Additional Records (since 1942). UNITED STATES. FLORIDA (recorded by J. Bequaert, 1942): Seminole Indian Reservation, Hendry Co., on *Odocoileus virginianus osceola*, Dec. 6, 1942 (H.S. Peters; W.R. Baldwin); 3 miles S. of Cox Lake, Collier Co., on *O. v. virginianus*, Nov. 21, 1936 (T.W. Cole). — GEORGIA (recorded by J. Bequaert, 1942): Camp Stewart, near Clyde, Bryan Co., on *O. v. virginianus* (R.H. McCauley, Jr.); Blackbeard I. Wild Life Refuge, McIntosh Co., on *O. v. virginianus* (E.A. Goldman; J.O. Harrison). — LOUISIANA: Madison Parish; Tensas Parish; Catahula Parish; Ouachita Parish; Union Parish; and Morehouse Parish; December, 1948 and 1951, all on *O. v. virginianus* (Louisiana State Board of Health; received through E.B. Johnson). — SOUTH CAROLINA: (recorded by J. Bequaert, 1942): Summerville, Dorchester Co., Oct. 8 (F.C. Bishopp). — TEXAS (recorded by J. Bequaert, 1942; Van Volkenberg and Nicholson, 1943; Randolph and Eads, 1947, as *M. ovinus;* Eads, 1949): Camp Bullis near San Antonio, Bexar Co., on *O. v. virginianus* (J.M. Brennan; T. McGregor); Lavaca Co., on *O. v. virginianus* (N.M. Randolph and R.B. Eads); Kleberg Co., on *Tayassu a. angulatus* (W.B. Davis. — Texas St. Dept. of Health); Kendall Co., on *O. v. virginianus* (A.C. Riba. — Texas St. Dept. Health); New Braunfels, Comal Co. (W.S. Ross) and 2 deälated specimens from a cow (H.J. Reinhard. — Texas St. Dept. Health); Leon Springs, 10 miles N. W. of San Antonio, Bexar Co., on *O. v. virginianus* (H.R. Roberts); Nixon, Gonzales Co.; Bandera, Bandera Co., on *O. v. virginianus* (H.E. Parish); Kimble Co. on *O. v. virginianus* (S.S. Bundy); Center Point, Kerr Co. on *O. v. virginianus* (H.E. Parish); Colorado Co.; Edwards Co., on *O. v. virginianus* (F.C. Bishopp); Gonzales, Gonzales Co., on *O. v. virginianus* (J.A. Deere).

MEXICO (recorded by Rondani, 1878; Townsend, 1897, as *L. depressa* var. *mexicana;* Austen, 1903, as *Lipoptena* sp.; J. Bequaert, 1942; de Buen, 1950): Apatzingan, State Michoacan, on *O. virginianus mexicanus* (R. Traub); State Chiapas (Esc. Nac.-Cienc.Biol.); San Rafael, State Vera Cruz, 4 specimens labelled *L. depressa* var. *mexicana,* collected by Townsend; [one ♀ labelled "cotype" by Brunetti]. — Brit.Mus.); Majahuita, 1 Kilom. W. of

Zihuatanejo, State Guerrero, on *O. virginianus mexicanus* [= *O. v. acapulcensis*] (Mrs. Ana María de Buen de Biagi).

Guatemala (recorded by J. Bequaert, 1942).

Republic of Honduras (recorded by J. Bequaert, 1942).

Panama (recorded by Ferris, 1930; J. Bequaert, 1942): Panama City (J.G. Sanders).

Colombia (recorded by Reyes, 1947, 1948; Renjifo-Salcedo, 1950): Municipio Río Negro, Dept. Santander, on deer (L.M. Murillo); Río Cesar, Valledupar, Dept. Magdalena, on *Mazama simplicicornis;* Río Mecaya, Dept. Caqueta, on *Mazama americana* (P. Hershkovitz); San-Juan-Nepomuceno, Dept. Bolivar, on *Mazama simplicicornis nemorivaga* (P. Hershkovitz).

Venezuela (recorded by Vogelsang, 1940, 1951, 1953; J. Bequaert, 1942; Fiasson, 1943, 1945, as *L. cervi;* Gallo and Vogelsang, 1951): Yagua, State Cojedes (H.A. Beatty); San Fernando, Apure River, State Apure, on *O. virginianus gymnotis* (R. Fiasson).

Trinidad (recorded by J. Bequaert, 1942): Heights of Aripa, on deer (M.A. Carriker, Jr.); Cumaca, on *Mazama rufa* (T.H.G. Aitken).

British Guiana (recorded by J. Bequaert, 1942).

Dutch Guiana (recorded by Bau, 1930, as *L. surinamensis;* J. Bequaert, 1942).

French Guiana: Oyapock, on "cariacu," *Mazama* sp. (H. Floch).

Brazil (recorded by Speiser, 1905, as *L. conifera;* J. Bequaert, 1942; Guimarães, 1944; Corrêa, 1952): Nova Teutonia near Itá, State Sa. Catharina, on *Mazama tema* and *M. americana* (F. Plaumann); Salobra, State Matto Grosso (Inst.Osw.Cruz).

Ecuador (recorded by J. Bequaert, 1942).

Peru: Pan de Azucar, Río Tarma, 1400 m., on "samaño," a small deer with very short legs (W. Weyrauch); Tingo María, 700 m., Río Huallaga, on *Mazama* sp. (W. Weyrauch).

Bolivia (recorded by Ferris and Cole, 1922; Bau, 1930; J. Bequaert, 1942).

Paraguay (recorded by J. Bequaert, 1942).

Uruguay (recorded by Calzada, 1939, as *L. cervi;* J. Bequaert, 1942).

Argentina (recorded by Falcoz, 1930).

L. mazamae is a common Neotropical deer-ked found in Mexico, Central and South America wherever the normal hosts, deer and brocket, occur. The southmost known occurrence is in the Chaco

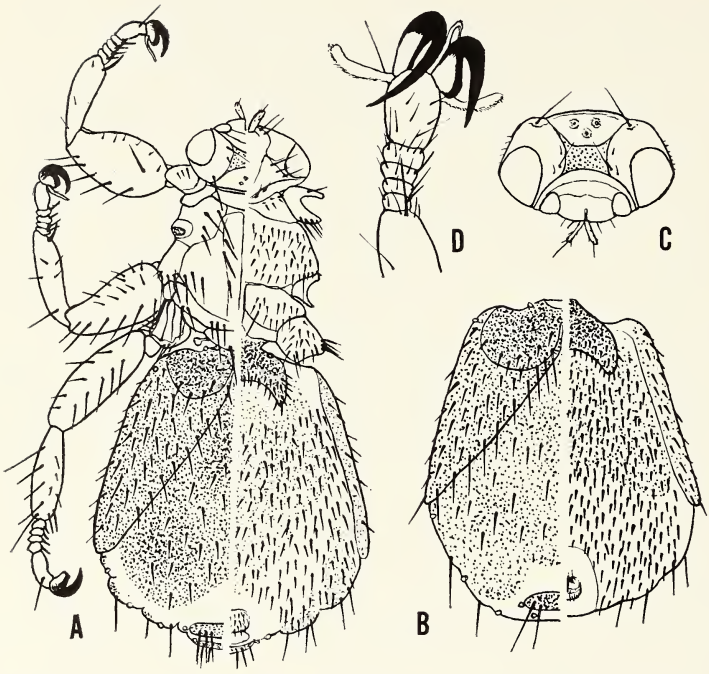

Fig. 101. *Lipoptena mazamae* Rondani. **A**, body dorsally and ventrally, ♀, Manaos, Brazil; **B**, abdomen dorsally and ventrally, ♂, Camp Pital, Panama, on *Mazama tema reperticia;* **C**, head, ♂, same data; **D**, tarsus and claws of mid leg, ♂, same data.

de Santiago del Estero, Argentina (27° 30′ S.). It extends northeastward beyond the Mexican border in the states bordering the Gulf of Mexico and along the Atlantic Coast as far as South Carolina (approximately to 33° 30′ N.). The area it occupies in the United States corresponds roughly to the Austroriparian Division of Merriam's Lower Austral Life Zone. It has not been taken as yet in Mississippi, Alabama, Arkansas and Tennessee. This may be due in part to lack of interested collectors, but, possibly also to the present scarcity or even absence of deer. *L. mazamae* may be expected to occur in Arkansas, however. Mr. E.B. Johnson pointed out to me (*in litt.*) that Union and Morehouse Parishes, Louisiana, where deer-keds have been taken, adjoin the southern boundary of Arkansas, and that three keds were found on deer less than 4 miles from the Arkansas line.

In the southeastern United States, the distribution of *L. mazamae* is sporadic and, when present, it does not seem to occur

in large numbers. Usually only a few deer in a given area carry keds or the parasite may be absent from certain sections within the general distributional area, even when deer are present. Most probably this is due to adverse climatic conditions, particularly the more severe winters recurring at irregular intervals in the southern United States, no section of which is without frost for many successive years. During the unusually severe winter of 1950–1951, Mr. E.B. Johnson, Entomologist of the Louisiana State Board of Health, searched 55 deer from 12 Louisiana parishes without finding a single ked. There had been some days with below-freezing temperatures even on the Gulf Coast from early November on, that is before the deer hunting season opened. A few keds had been taken some years earlier in December from a deer in Madison Parish. During the next winter (1951–1952), however, keds were found on deer in six parishes, all in the northern half of the state. *L. mazamae* is essentially a tropical insect, which struggles to maintain itself in the southeastern United States by taking advantage of the hot and humid summers. It is one of several similar Neotropical elements in the southeastern section of the Nearctic Region.

Bionomics. Throughout its range, *L. mazamae* is a normal parasite of all species and subspecies of deer (*Odocoileus*) and brocket (*Mazama*). Thus far, there are precise records from the following hosts: *Odocoileus v. virginianus* Boddaert, *O. virginianus osceola* (Bangs), *O. v. mexicanus* (Gmelin) (= *O. v. toltecus* de Saussure; *O. v. acalpulcensis* Caton), *O. v. gymnotis* (Wiegmann), *O. v. rothschildi* (Thomas), *Mazama t. tema* Rafinesque, *M. t. reperticia* Goldman, *M. s. simplicicornis* (Illiger), *M. simplicicornis nemorivaga* (Cuvier), and *M. americana* (Erxleben). There are now three records of *L. mazamae* occurring accidentally on domestic cattle (in Venezuela, Georgia and Texas). Other recorded stray hosts are the grison (*Tayra barbara* Linnaeus) and the pecari (*Tayassu a. angulatus* Cope). Guimarães (1944) described and figured the puparium, which is similar to that of *L. depressa;* but very little is known otherwise of the life-history and behavior.

My monograph (1942*a*) contains copies or translations of the original descriptions of *Lipoptena mazamae* and of its three synonyms.

The types of *L. depressa* var. *mexicana* Townsend are not lost, as I supposed (1942*a*, p. 132). This form was originally based on 153 cotypes. At least 4 of these were sent to the late E. Brunetti, in England, and were eventually acquired by the British Museum,

where I saw them in 1951. Both sexes are present in this lot; but only a female was labelled "cotype" by Brunetti; all are labelled "San Rafael, Vera Cruz," a locality only a few miles from Paso de Telaya (20° 20′ N., 96° 50′ W.), given by Townsend. The 4 specimens agree in every respect with what I have been calling *L. mazamae*. The present whereabouts of the other cotypes is unknown; but some of them will probably turn up eventually in other collections.

The statement referring to the type of *Lipoptena mazamae* Rondani (1942*a*, p. 131) also needs correction. Speiser (1904*a*, p. 334) never saw Rondani's type. He merely concluded from a study of the descriptions of *L. depressa* (Say) and *L. mazamae* that both were the same species. Ferris and Cole (1922, p. 185) pointed out that this was an error and gave the first recognizable description and figures of *mazamae*. I have not been able to trace Rondani's type; it could not be found at the Genoa Museum, in Bellardi's collection at the University Zoological Museum in Turin, or in Rondani's personal collection now at the Museum in Florence; most probably it is lost permanently.

Lipoptena (Lipoptenella) guimaraesi, new species
Figs. 102*A–D*

Female. Head (Fig. 102*C*) moderately lengthened behind the eyes, seen in front nearly elliptical, about $1\frac{2}{5}$ times as wide as high; mediovertex short and wide, a little less than half the length of frons as well as of postvertex; a very weak interantennal suture and a more pronounced suture setting off a preptilinal area; inner orbit narrower than eye, bearing 3 long bristles and a shorter one closer to the antenna; one very long vertical bristle; postvertex long and broad, about as long as frons, longer than in *L. depressa* and *L. mazamae;* ocelli distinct, in a nearly equilateral triangle. Palpi slightly shorter than frons. Thorax (Fig. 102*A*) dorsally: pro-mesonotal suture well marked; median notal suture very weak or lacking; transverse mesonotal suture present, broadly interrupted medially; traces of longitudinal intrascutal grooves; posthumeral suture weak, but complete; prothoracic spiracle large, at latero-posterior edge of humeral callosity; 5 acrostichals in a curved row; 5 or 6 latero-centrals, forming a transverse group connecting the posterior acrostichals with the preälar group of mesopleurals; 4 or 5 humerals; 5 or 6 prescutellars; 3 long and a few shorter mesopleurals at apex of anepisternum; 2 scutellars (1 median pair). Thorax ventrally: lobes of prosternum with 6 or 7

long and short, stout setae; basisternum of mesothorax and of metathorax mostly covered with spaced, short, stiff setae, in irregular transverse rows; furcasternum of metathorax bare. Abdomen (Fig. 102*A*) dorsally: basal dorsal pleurite (laterotergite I) large, wider than long, fairly well set off from the 2nd dorsal pleurite (laterotergite II) in older, fully sclerotized specimens, with an apical row of setae; laterotergite II well sclerotized in older specimens, very long, elongate triangular with the inner side slanting toward the basal median notch between the 2 laterotergites I, uniformly covered with spaced, stiff, moderately long setae; only 2 median tergal, smooth, sclerotized plates close to the tip of the abdomen (as in *L. mazamae*), corresponding to the 4th and 5th preäpical sclerites of some other species of *Lipoptena*, as shown by the position of the 6th and 7th spiracles; 4th sclerite a continuous, transverse, semi-elliptical plate, broader than in *L. depressa*, with a transverse preäpical row of 6 long setae (3 on each side); 5th sclerite narrowly divided in the middle, much smaller than the 4th, each half with 3 long setae; in addition to these well-defined sclerites, a very small area, bearing a median pair of setae, is set off by a slight, curved groove immediately before the 4th sclerite; but this area is membranous, dull and with the same alutaceous sculpture as the surrounding dorsum. Sixth abdominal spiracle outside the 4th sclerite, but close to its outer hind edge; 7th at the outer edge of the 5th sclerite or somewhat within it. Median area of dorsum, outside the basal laterotergites and the smooth apical sclerites, membranous or more or less sclerotized, dull, coarsely alutaceous, and fairly uniformly covered with spaced, stiff, moderately long setae. Abdomen ventrally: basal, strongly sclerotized, ventral sclerite deeply emarginate, crescent-shaped as in *L. mazamae*, the side lobes bluntly triangular, with a few heavy setae in a marginal row and over posterior half; venter otherwise membranous and uniformly covered with spaced, moderately long setae, about as in *L. depressa*. Legs thick, moderately setose, as in *L. mazamae;* apical spur of fore tibia stout, spine-like; mid tibia with 3 apical spurs (Fig. 102*D*), the middle one very long, the 2 outer ones much shorter; claws nearly symmetrical in a pair. Wing unknown.

Male. Similar to the female in structure and chaetotaxy. Abdomen (Fig. 102*B*) with only one median dorsal smooth plate at apex, corresponding to the 4th of the female, as shown by the position of the 6th spiracle close to its outer edge (as in *L. mazamae*); the sclerite with a group of 3 long setae in each corner; a

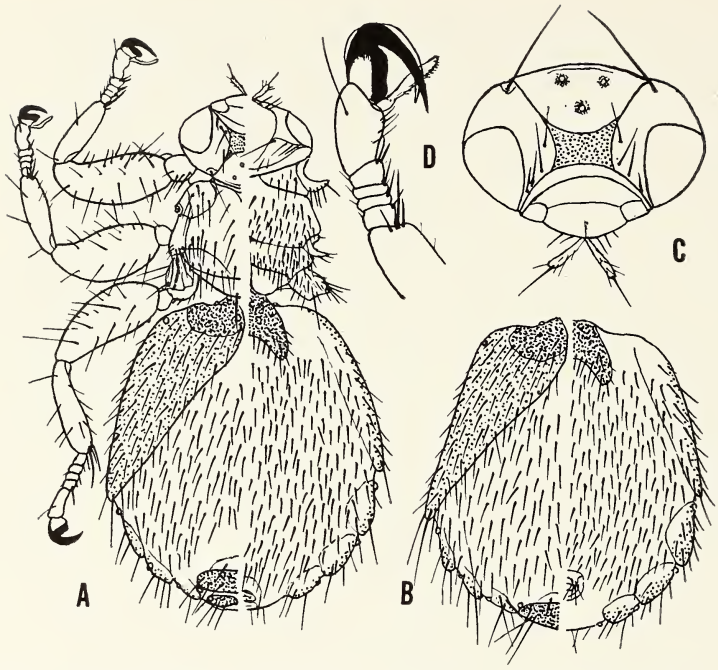

Fig. 102. *Lipoptena guimarãesi* J. Bequaert. **A**, body dorsally and ventrally, ♀ holotype, Rio das Mortes, Brazil, on *Ozotoceros bezoarticus;* **B**, abdomen dorsally and ventrally, ♂ allotype, same data; **C**, head, ♀ holotype, same data; **D**, tarsus and claws of mid leg, ♀, same data.

superficially defined, not sclerotized, dull, alutaceous area, bearing a median pair of setae, basad of the 4th sclerite, as in the female.

Length (head + thorax): ♀, 1.6 to 1.7 mm.; ♂, 1.4 to 1.5 mm.; total length of fed, fully sclerotized, deälated specimens preserved in alcohol, up to about 4.3 mm. in ♀, 3.5 mm. in ♂.

Brazil. Rio das Mortes, San Domingo, State Matto Grosso, ♀ holotype, ♂ allotype, and 1 ♀, 1 ♂ paratypes, on pampas deer, *Ozotoceros bezoarticus;* Rio das Mortes, Pindaiba, State Matto Grosso, 1 ♀ paratype, on *Ozotoceros bezoarticus;* Corrego da Saudade, State Goyaz, 1 ♀, 1 ♂ paratypes, on *Ozotoceros bezoarticus.* Also 8 ♂, 2 ♀ and 7 newly hatched, deälated, unfed specimens of doubtful sex, without locality or host data, but from Brazil. All specimens preserved in alcohol and received from the Departamento de Zoologia of the State of São Paulo, where holotype, allotype and most paratypes are deposited; a few paratypes at the Mus.Comp.Zool., Cambridge, Mass. (No. 29559).

L. guimaraesi combines some of the characters of *L. depressa* and of *L. mazamae*, as may be gathered from the key. It differs from either in the number of apical spurs of the mid tibia and in the longer postvertex. The chaetotaxy of head and mesonotum are more like that of *L. depressa;* but it has the stout spur of the fore tibia and the reduced median dorsal sclerites of *L. mazamae.*

This species is known only from the pampas deer, *Ozotoceros bezoarticus*, a member of the family Cervidae in the order Artiodactyla, with a present-day limited distribution from Bolivia and southern Brazil to northern Patagonia. Presumably it is a specific parasite of this host.

Melophagus Latreille, 1802

Melophagus Latreille, 1802 (An X), Hist. Nat. Crust. Ins., **3**, p. 466 (monotypic for *Hippobosca ovina* Linnaeus, 1758). J. Bequaert, 1942, Entomologica Americana, (N.S.), **22**, p. 157 (full synonymy).

A detailed generic description is given in my Monograph (1942*a*), where I divide the genus into two subgenera, both monotypic: *Melophagus*, proper, (for *M. ovinus*), and *Dorcadophagus* (for *M. rupicaprinus* Rondani). It was originally restricted to the Palearctic Region of the Old World. *M. ovinus*, the sheep-ked, has been widely distributed by Man with its host and in this manner reached the New World since Columbus' time.

Melophagus ovinus (Linnaeus)

Figs. 15, 16*A–D*, 17*A–C*, 18*D*, 103*A–D*, and 104*A–G*

Hippobosca ovina Linnaeus, 1758, Syst. Nat., 10th Ed., **1**, p. 607 (no sex; "*inter ovium lanam,*" without locality; saw specimens from southern Sweden. Type lost). Ramdohr, 1809, Abbildungen Anatomie Insecten, p. 22; Pl. 21, fig. 6; 1811, Abhandlung über die Verdauungswerkzeuge der Insecten, p. 185; Pl. 21, fig. 6 (digestive system).

Hippobosca ovis Hicks, 1860, Trans. Linn. Soc. London, **23**, pt. 1, p. 140; Pl. 18, fig. C2 (sensory organs on legs).

Melophagus ovinus montanus Ferris and Cole, 1922, Parasitology, **14**, pt. 2, p. 192, figs. 9*E* and 10 (♂. Alaska-Yukon Boundary, on either *Ovis dalli* or *Ovis canadensis.* Types at Stanford Univ. Mus., Palo Alto). Essig, 1926, Insects Western North America, p. 621.

Melophagus ovinus form *bolivianus* Bau, 1930, Stettin. Ent. Zeitg., **91**, pt. 2, p. 176 (♀ ♂; no host. Oruro, Bolivia. Types formerly at Hamburg Mus., now lost; paratypes at Stanford Univ. Mus., Palo Alto).

The following references, mainly to American publications, supplement those of my Monograph (1942*a*).

Melophagus ovinus Lintner, 1882, **1st** Ann. Rept. Injurious Other Insects New York, p. 62. Howard, 1883, South Carolina, Resources and Population, p. 275. Stiles and Hassall, 1893, U.S. Dept. Agric., Bur. Anim. Ind., Bull. **4**, p. 87. J.B. Smith, 1894, Rept. New Jersey Agric. Coll. Expt. Sta., (for 1893), p. 511, fig. 50. Kellogg, 1905, American Insects,

p. 351, fig. 502 (also in 2nd Ed., 1908). Daniels and Stanton, 1907, Studies in Laboratory Work, 2nd Ed., pp. 192 and 193, fig. 94. Haimbach, 1907, Ent. News, **18**, p. 208 (Pennsylvania: Philadelphia). Kaupp, 1908, Animal Parasites Parasitic Diseases, p. 25, figs. 2–3. Torreggiani, 1909, Bol. Min. Col. Agric. Bolivia, **5**, pp. 68 and 69 (Bolivia). Wolffhügel, 1911, Revista Centro Estudiantes Agronomia Veterinaria, Buenos Aires, **3**, (for 1910), Nos. 24–26 (reprint: Buenos Aires, 1911, pp. 10 and 13; in Argentina); 1912, Rev. Medic. Veter. Esc. Montevideo, **2**, (for 1911), Nos. 10–11, p. 462 (Argentina: Prov. Córdoba. Biting Man). Hall, 1912, Colorado College Publ., Science Ser., **12**, No. 10, p. 360 (Colorado: Fort Collins; Resolis; Amo; Colorado Springs). Herms, 1913, California Cultivator, 41, p. 290. Torreggiani, 1914, Nuovo Ercolani, **19**, p. 421 (Bolivia). Herms, 1915, Medical Veterinary Entomology, p. 294, fig. 185 (adult, puparium). Lutz, 1918, Field Book Insects, pp. 277 and 279; Pl. 71, fig. Linton, 1921, Veterinary Hygiene, p. 349. Sanderson, 1921, Insect Pests Farm Garden Orchard, 2nd Ed., (by L.M. Peairs), p. 669, fig. 589. Hoffman, 1922, Rept. New York State Vet. Coll., Cornell Univ., (for 1920–1921), p. 201. Craig, 1923, in Wooldridge, Encyclopaedia Veterinary Medicine, **1**, Veter. Med., p. 500. Herms, 1923, Medical Veterinary Entomology, 2nd Ed., p. 349, fig. 186. J.H. Comstock, 1924, Introduction to Entomology, p. 874, fig. 1119 (also in later printings). Fernald, 1926, Applied Entomology, 2nd Ed., p. 333, figs. 351 (engorged ♀) and 352 (newly-emerged). Edwards and Shannon, 1927, Rev. Inst. Bacter., Buenos Aires, **4**, No. 7, p. 658 (southern Chile, on sheep). Brittain, 1927, Prov. Nova Scotia Dept. Natural Recources, Bull. No. **12**, p. 106, fig. 43, and p. 157. Metcalf and Flint, 1928, Destructive Useful Insects, p. 803, fig. 540. Hall, 1928, Parásitos Ganado America Latina (Union Panamericana, Agricultura No. **47**), p. 27; 1929, U.S. Dept. Agric., Farmers' Bull. **1330** (revised), p. 5, fig. 4 (also revised in 1932 and 1933). Veintemillas, 1935, El Tifus Exantemático Boliviano o el Tifus Altiplánico, La Paz, p. 90. Babcock and Parish, 1936, Insect Pest Survey Bull., (mimeographed), **16**, No. 4, p. 146 (Texas: on sheep and goat at Sonora, Ozona Junction; on sheep near Menard). Hall, Dikmans, and Wright, 1936, U.S. Dept. Agric., Farmers' Bull. **1330**, (revised), pp. 5–7, fig. (also revised in 1938, 1944 and 1946). Babcock, 1938, **51st** Ann. Rept. Texas Agric. Expt. Sta., pp. 224–225. Brittain and Pickett, 1938, Prov. Nova Scotia Dept. Agric., Ent. Div., Bull. No. **12**, (revised), pt. 2, p. 86, fig. 15, and p. 159. Knowlton, Harmston, and Stains, 1939, Utah Agric. Expt. Sta., Mimeogr. Ser., **200**, pt. 5, p. 19 (occurrence in Utah). Wille, Ocampo, Wederbauer, and Schofield, 1939, Min. Fomento, Dir. Agric. Ganad., Lima, Peru, Bol. No. **16**, (revised Bol. No. **11**, 1937), p. 96 (Peru; control). Babcock, 1940, **52nd** Ann. Rept. Texas Agric. Expt. Sta., (for 1939), p. 246. Mail, 1940, War-Time Prod. Ser., Agric. Suppl. Board, Ottawa, Spec. Pamphl. No. **13**, p. 1 (Canada). Hurtado, 1940, Manual Parasitología Médica, Guatemala, (1938), p. 240. James, 1940, Sheep Breeder, Chicago, **60**, No. 2, pp. 3 and 19. Shull and Fisher, 1940, Univ. Idaho, Ext. Bull. **129**, pp. 51–52. Willman, 1941, Americ. Agric., **138**, p. 291. Horlacher and Hammonds, 1942, Sheep, 2nd Ed., pp. 229–232. Gwatkin, Painter, and Moynihan, 1942, Canadian Jl. Comp. Med. Vet. Sci., **6**, No. 6, p. 163 (Alberta: Whitla District). J. Bequaert, 1942, Bol. Entom. Venezolana, **1**, No. 4, p. 8; 1942, Entomologica Americana, (N.S.), **22**, p. 160, figs. 2*A–C*, 17*A–G*, and 18*A–D* (bibliography). Essig, 1942, College Entomology, pp. 813 and 815, fig. 305. Whitehead, 1942, Macdonald College, Farm Bull. **7**, p. 26; Pl. 3, fig. 6 (Quebec). Imes and Babcock, 1942, U.S. Dept. Agric., Yearbook for

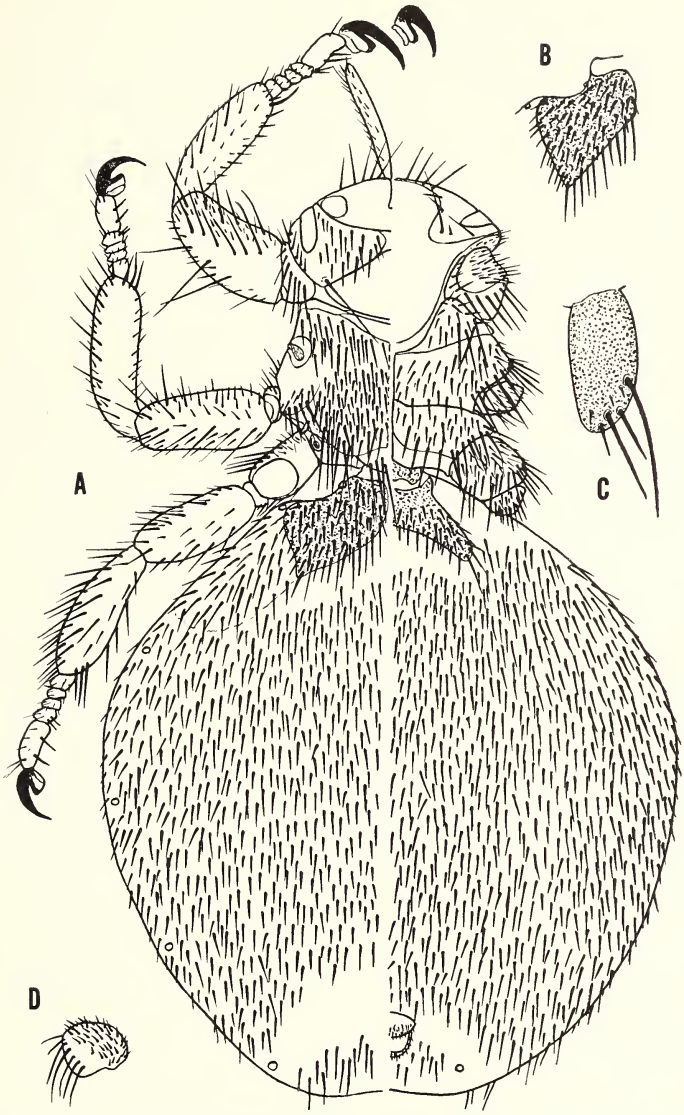

Fig. 103. *Melophagus ovinus* (Linnaeus). **A**, body dorsally and ventrally, ♀, Midland Co., Michigan; **B**, basal laterotergite, ♂, Bogotá, Colombia; **C**, rudiment of wing, ♂, same data; **D**, dorsal aspect of fore coxa, ♂, same data.

1942, "Keeping Livestock Healthy," pp. 912–916, figs. 1*A–B* and 2. Schwardt and Matthysse, 1942, **55th** Rept. New York Agric. Expt. Sta., Cornell, p. 127; 1943, *idem*, **56th** Rept., Cornell, p. 121. Mohler, 1943, U.S. Dept. Agric., Bur. Anim. Ind., Rept. for 1942, pp. 42–43. Day, 1943, Psyche, **50**, pp. 1–8, Pl. (corpus allatum). Marsh, 1943, Montana Wool Grower, **17**, No. 6, p. 11. Smith and Benner, 1943, New Mexico Agric. Expt. Sta., Entom. Circ. **153**, (revised), p. 33. Woodbury, 1943, Amer. Assoc. Adv. Sci., Publ. No. **20**, p. 72 (rearing). Imes and Babcock, 1943, Sheep and Goat Raiser, **24**, p. 18. McIndoo, 1943, U.S. Dept. Agric., Bur. Ent. Plant Quar., **E-597**, (mimeographed), p. 16. R.C. Smith, 1943, Common Insects Kansas, p. 379, fig. 414. Schwardt and Matthysse, 1943, Jl. Econ. Entom., **36**, p. 105. Thomssen and Doner, 1943, Soap, **19**, p. 133. Cobbett and Smith, 1943, Jl. Amer. Vet. Med. Assoc., **103**, p. 6, fig. 1. Snodgrass, 1943, Smithson. Misc. Coll., **104**, No. 1, pp. 44 and 46; figs. 16*B*, *C* and *F*, and 17*B*, *C* and *H* (mouth-parts); 1944, *Op. cit.*, **104**, No. 7, pp. 78, 79, 80, 81; figs. 30*B*, *C* and *F*, and 31*B*, *C* and *H* (mouth-parts). Ackert (*et al.*), 1944, Proc. **47th** Ann. Meet. U.S. Live Stock Sanit. Assoc., (1943), pp. 69 and 72. Cobbett and Smith, 1944, North Amer. Vet., **25**, p. 536; 1944, Wyoming Wool-Grower, **8**, No. 14, pp. 1 and 3–5. Hancock, 1944, Nova Scotia Dept. Agric., Bull. **10**, pp. 53–55. Shull, 1944, Univ. Idaho, Bull. **252**, p. 46. Munro, 1944, Jl. Econ. Entom., **37**, pp. 350–351. Miller, 1944, U.S. Dept. Agric., Bur. Anim. Ind., Rept. for 1943–1944, p. 37. Kemper, 1945, New Mexico Stockman, **10**, No. 1, p. 38, fig. Conn, 1945, Sheep Health, 2nd Ed., pp. 106–107. McEwan and Ewen, 1945, Sci. Practice Canadian Anim. Husbandry, Revised Ed., pp. 329–330. Johnson, 1945, Sheep Breeder, Chicago, **65**, No. 11, p. 6. Gunn, 1945, **39th** Ann. Rept. Dept. Agric. British Columbia, (for 1944), p. 84. Roark, 1945, U.S. Dept. Agric., Bur. Ent. Plant. Quar., **E-652**, (mimeographed), p. 27. Ballou, 1945, Cuaderno Verde No. **34**, Com. Organ. 3a Conf. Interamer. Agric., Caracas, pp. 76 and 125 (Venezuela; Mucurubá, State of Mérida). Herman, 1945, California Fish Game, **31**, pp. 17 and 20, fig. 9*D*. Dikmans, 1945, Amer. Jl. Vet. Res., **6**, p. 228. Cobbett and Smith, 1945, California Wool Grower, **21**, No. 39, p. 8; 1945, Jl. Amer. Vet. Med. Assoc., **107**, p. 147. Matthysse, 1945, Jl. Econ. Entom., **38**, p. 285. Freire, 1945, Bol. Dir. Prod. Animal, Sec. Agric. Ind. Com., Rio Grande do Sul, **1**, pt. 2, pp. 22, 27 [as *Mellophagus ovinus*], and 37 (Brazil: Rio Grande do Sul). Benbrook, 1945 List Parasites Domesticated Animals North America, 1st Ed., p. 35 (reprinted, 1946 and 1948). Schwardt and Matthysse, 1945, New York [Geneva] Farm Res., **11**, No. 2, pp. 11-12. Schwardt, 1945, *Op. cit.*, **11**, No. 4, pp. 4–5. Schwardt (*et al.*), 1945, **57th** Rept. New York Agric. Expt. Sta. Cornell, p. 124; 1946, *idem*, **58th** Rept., p. 119. Moreno, 1945, Almanaque Minist. Agric. Nac., Buenos Aires, **20**, p. 287; 1946, Campo y Suelo Argent., **30**, No. 351, p. 6. Gunn, 1946, 40th Ann. Rept. Dept. Agric. British Columbia, (for 1945), pp. V114–V115. Manson (*et al.*), 1946, Canadian Ins. Pest Rev., **24**, p. 103. Peters and Deyoe, 1946, Raising Livestock, pp. 289–290. Schwartz, 1946, Proc. **49th** Ann. Meet. U.S. Livestock San. Assoc., (1945), p. 75. Daggy (*et al*), 1946, Minnesota Agric. Expt. Sta., Ext. Bull. **252**, p. 9. Leary, Fischbein, and Salter, 1946, DDT and the Insect Problem, p. 91. Telford and Guthrie, 1946, Agric. Chem., **1**, No. 3, p. 30. Harney, 1946, National Wool Grower, **36**, No. 6, pp. 17–18. Manis, 1946, Idaho Coll. Agric., News Letter **31**, pt. 1, p. 3. Shull (*et al.*), 1946, Univ. Idaho, Ext. Bull. **268**, p. 38. Muma, 1946, Univ. Nebraska Coll. Agric., Extension Circ. **1539**, p. [2; unnumbered]. Rude and Parish, 1946, U.S. Dept. Agric., Bur. Ent. Plant Quar., **E-679**, (mimeographed), p. 1. Procter, 1946, Biol. Surv. Mt. Desert, **7**, Insect Fauna,

p. 437. Steinhaus, 1946, Insect Microbiology, pp. 54, 205, 244, 312, 313, and 480; figs. 115–117 and 202–203 (*Rickettsia melophagi; Trypanosoma melophagium*). Stuardo, 1946, Catálogo Dípteros Chile, p. 187. Kemper, Roberts, Smith, and Cobbett, 1947, Jl. Amer. Vet. Med. Assoc., **111**, p. 196. Schwartz (*et al.*), 1947, Proc. **50th** Ann. Meet. U.S. Livestock San. Assoc., (1946), p. 97. Roveda and Ringuelet 1947, Gaceta Veter., Buenos Aires, **9**, No. 46, p. 70. Anduze, Pifano, and Vogelsang, 1947, Bol. Entom. Venezolana, Num. Extra, p. 6. Twinn, 1947, Dept. Agric. Canada, Div. Entom., Processed Bull. **65**, pp. 8 and 10. Beatty, 1947, Jl. Agric. Univ. Puerto Rico, **28**, pts. 3–4, (for 1944), p. 155 (St. Croix I.). Stuckey, 1947, **59th** Rept. Georgia Agri. Expt. Sta., p. 49. E.T. Baker, 1947, Management and Feeding of Sheep, pp. 217–223. Gardiner, 1947, Rept. Canadian Min. Agric., (for 1945–1946), p. 157. Price, 1947, Kentucky Agric. Expt. Sta., Ext. Circ. **438**, pp. 4–5. McDonald, 1947, North Dakota Agric. Expt. Sta., Ext. Circ. **190**, pp. 33–35, fig. Trullinger (*et al.*), 1947, U.S. Dept. Agric., O.E.S. Rept., (for 1945–1946), p. 112. Munro, 1947, Proc. Amer. Assoc. Econ. Entom., N. Centr. States Branch, **2**, p. 36. Gregson and Manson, 1947, Canad. Insect Pest Rev., **25**, p. 115. O'Connell, 1947, Wool Sack, **15**, No. 8, p. 2. Manis (*et al.*), 1947, Univ. Idaho, Ext. Bull. **269**, p. 30. Reyes, 1947, Rev. Grancolombiana Zoot. Hig. Med. Vet., Caracas, **1**, Nos. 10–12 p. 707 (Colombia); 1948, Rev. Med. Vet., Bogotá, **17**, No. 96, p. 71 (Colombia). Schwartz, 1948, U.S. Dept. Agric., Yearbook for 1943–1947, pp. 73–74. Telford, 1948, Jl. Econ. Entom., **40**, (for 1947), pt. 6, p. 921. MacArthur, 1948, Bull. Publ. Mus. Milwaukee, **8**, pt. 4, p. 431, figs. 232 (distribution in Wisconsin) and 256 (Wisconsin: Madison, Dane Co.; Sun Prairie). Kemper, Cobbett, and Roberts, 1948, North Amer. Veter., **29**, pt. 7, pp. 422 and 424. H.H. Ross, 1948, Textbook of Entomology, p. 421, fig. 383. Ringuelet, 1948, Publ. Misc. Min. Agric. Argentina, No. **281**, pp. 41, 47, and 49 (Argentina: Abra Pampa, Jujuy, on goat; Carahuasi, Jujuy; Javimana, Molinos, Salta; Rosario de Lerma, Salta; zona cordillera, Salta; Concepción, Tucumán; Santa María, Catamarca; Chos Malal, Neuquen; Piedra Parada, Lanquineo, Chubut; Tehuelches, Chubut; Trelew, Chubut). Schwardt and Matthysse, 1948, Cornell Univ. Agric. Expt. Sta., Bull. **844**, pp. 1–33, fig. on cover (adult) and fig. 1 (p. 3: puparium). Swain, 1948, The Insect Guide, p. 214, fig. 174*a*. Goodman, 1948, San Luis Valley Farmer Stockman, **2**, No. 24, p. [10; unnumbered]. Watson, 1949, Jl. Amer. Vet. Med. Assoc., **115**, pp. 176 and 177 (Peru: in Andes between 10,000 and 15,000 ft.). Tibbetts and Sorenson, 1949, Farm Home Sci. [Utah State], **10**, pt. 1, p. 14. Steinhaus, 1949, Principles Insect Pathology, pp. 146, 155 and 156 (*Rickettsia melophagi*). Dicke, 1949, Proc. Amer. Assoc. Econ. Entom., N. Centr. States Branch, **4**, (mimeographed), p. 84. Florenzano, 1949, Redia, Florence, (2), **34**, p. 127 (*Bacillus anthracis*). Dicke, Pope, Bray, and Hanning, 1949, Jl. Agric. Res., **78**, p. 565. Pepper, Hitchcock, Hunt, and Schmiedeskamp, 1949, Montana Agric. Expt. Sta., **32nd** Rept. State Entom., Bull. **457**, p. 23. Denning, 1949, Jl. Econ. Entom., **42**, p. 852. Fairchild, Hoffman, Lindquist, and Mote, 1949, *Op. cit.*, **42**, p. 410. Gjullin, 1950, *Op. cit.*, **42**, (for 1949), pt. 6, p. 984. Hoffman, Roth, and Lindquist, 1950, *Op. cit.*, **42**, (for 1949), pt. 6, p. 893. Hoffman, 1950, *Op. cit.*, **42**, (for 1949), pt. 6, p. 984 (control of puparia). Ure (*et al.*), 1950, Rept. Alberta Dept. Agric. for 1949, p. 40. Seghetti and Firehammer, 1950, Jl. Amer. Vet. Med. Assoc., **117**, p. 447 (Montana). Schwardt, 1950, Agric. Chem., **5**, pt. 3, p. 88. Webber, 1950, in Craighead, Insect Enemies Eastern Forests, (U.S. Dept. Agric. Misc. Publ. No. **657**), (for 1949), p. 529. Herms, 1950, Medi-

cal Entomology, 4th Ed., p. 410, fig. 136. Denning and Pfadt, 1950, Wyoming Agric. Expt. Stat., Dept. Entom., (processed), p. 2. Manis and Portman, 1950, Idaho Agric. Expt. Sta., Bull. **279**, p. 66. de Buen, 1950, An. Inst. Biologia, México, **21**, pt. 2, p. 415 (Mexico: Chapingo, State Mexico, 2700 m., on sheep and goat; Temamatla, State of Mexico, 2200 m., on sheep). J. Bequaert, 1951, Agricultura Técnica, Santiago de Chile, **10**, (for 1950), p. 7. Crichton, 1951, Ent. Mo. Mag., **87**, p. 21 (main island of Tristan da Cunha). Craig and Faust, 1951, Clinical Parasitology, 5th Ed., p. 722. Simms, 1951, U.S. Dept. Agric., Bur. Anim. Ind., Rept. for 1949–1950, pp. 61–62. Hegner and Stiles, 1951, College Zoology, 6th Ed., p. 324, fig. 161*E*. Storer, 1951, General Zoology, 2nd Ed., p. 527, fig. 23 (29*F*). Wolcott, 1951, Jl. Agric. Univ. Puerto Rico, **32**, (for 1948), pt. 3, p. 530. Seghetti, 1951, Montana Wool Grower, **25**, No. 4, p. 9 (control). Belschner, 1951, Sheep Management Diseases, 2nd Ed., p. 608, fig. 309 (probably same in 1950 Ed.). Makino, 1951, Atlas Chrososome Numbers Animals, p. 212. Pepper, Corkins, Schmiedeskamp, Hunt, Anderson, and Wright, 1951, Montana Agric. Expt. Sta., **33rd** Rept. State Entom., Bull. **474**, p. 30. Knipling, 1951, U.S. Agric. Bur. Ent. Plant Quar., **E-762**, (2nd Revision), pp. 3, 7, 9, and 12–13. Schwartz (*el al.*), 1951, Proc. **54th** Ann. Meet. U.S. Livestock Sanit. Assoc., (1950), p. 258. Gardiner, 1951, Min. Agric. Canada, Rept. for 1950–1951, p. 13. Hagan, 1951, Embryology of the Viviparous Insects, pp. 161–203, figs. 35–49 (development). Metcalf and Flint, 1951, Destructive Useful Insects, 3rd Ed., p. 939, figs. 560–562. Hoffman and Lindquist, 1951, Jl. Econ. Entom., **44**, pt. 6, p. 928. Gallo and Vogelsang, 1951, Rev. Med. Veter. Paras., Caracas, **10**, Nos. 1–4, p. 35 (Venezuela). Robb, 1952, Rec. Stockman, Annual Ed., (for 1952), pp. 222 and 224. Muma, Hill, Hixson, and Harris, 1952, Jl. Econ. Entom., **45**, pt. 5, p. 833. Benbrook, 1952, List Parasites Domesticated Animals North America, 2nd Ed. (revised), p. 52. (Anonymous), 1952, Univ. Illinois, Agric. Expt. Sta., Circ. **698**, p. 123, fig. Corrêa, 1952, Bol. Dir. Prod. Anim., Rio Grande do Sul, **8**, No. 13, p. 4; Pl., fig. 2 (Brazil: Rio Grande do Sul). Chagnon, 1952, Contrib. Inst. Biol. Université Montréal, No. **32**, p. 34 (Quebec). Knipling and Bishopp, 1952, Trans. IXth Internat. Ent. Congr. Amsterdam, (1951), **1**, p. 933. Newsom, 1952, Sheep Diseases, p. 137, fig. 54. Riley and Wallace, 1952, Introduction Study Animal Parasites, 6th Ed., p. 77. Pfadt and DeFoliart, 1952, Wyoming Agric. Expt. Sta., Mimeogr. Circ. **23**, p. 1. Kemper, 1952, National Wool Grower, **42**, pt. 7, p. 21. Belding, 1952, Textbook Clinical Parasitology, 2nd Ed., p. 838. Hedeen, 1953, Texas Jl. Sci., **5**, pt. 1, p. 129 (Texas: Fort Hood). Pfadt, Paules, and DeFoliart, 1953, Jl. Econ. Entom., **46**, p. 95. Tagle, 1953, Agricultura Técnica, Santiago de Chile, **13**, Pt. 2, pp. 96 and 107. Strickland, 1953, Canadian Jl. Zool., **31**, No. 3, p. 290, fig. 50 (ptilinum). Kemper and Peterson, 1953, U.S. Dept. Agric., Farmers' Bull. **2057**, pp. 1–22, figs. 1*A*, 2*A–C*, 3*A–B*, 4, and 5. Snodgrass, 1953, Smithson. Misc. Coll., **122**, No. 3, pp. 13, and 18, fig. 4 (development of larval head). Longhurst and Douglas, 1953, Trans. **18th** North Amer. Wildlife Conf., pp. 177 and 183 (California: Hopland, Mendocino Co.). León and Castillo de León, 1953, Rev. Ecuatoriana Ent. Paras., **1**, No. 4, p. 55 (Ecuador: common in the Altiplano). Kemper, Cobbett, and Peterson, 1953, Vet. Medicine, **48**, p. 483. Nelson and Slen, 1953, Canadian Jl. Agric. Sci., **33**, p. 620 (Alberta: Lethbridge). Nelson, 1953, Proc. Canadian Soc. Anim. Prod., (mimeographed), p. [17]; 1953, Agric. Institute Rev., Ottawa, **8**, pt. 3, p. 34. Pfadt, DeFoliart, and Robb, 1953, Wyoming Agric. Expt. Sta., Bull. **327**, pp. 37 (fig.) and 55. Gregson,

1953, Proc. 7th Pacific Sci. Congr., (New Zealand, 1949), **4**, pp. 146 and 187 (British Columbia). Borror and DeLong, 1954, Introduction Study Insects, p. 643, fig. 27 (91). Whiting, Nelson, Slen and Bezeau, 1954, Canadian Jl. Agric. Sci., **34**, p. 70. Hill, Hixson, and Harris, 1954, Nebraska Agric. Expt. Sta. Q., **3**, Summer Issue, p. 8, fig. Jones, 1954, Veterinary Pharmacology Therapeutics, p. 586. White, 1954, Animal Cytology Evolution, 2nd Ed., p. 222. Hoffman, 1955, Jl. Econ. Entom., **48**, p. 629 (ecology). Pfadt and Ryff, 1955, *Op. cit.*, **48**, p. 195.

References using only a vernacular name (sheep-tick or ked): Perkins, 1880, **6th** Rept. Vermont Bd. Agric., p. 58, fig. 2 (uses "sheep-tick" [not *M. ovinus*, as listed in 1942*a*], p. 164). Gaiger, 1917, Jl. Comp. Path. Therap., **30**, p. 187 (Peru: in Andes above 10,000 ft).) Bell, 1922, Mo. Bull. Ohio Agric. Expt. Sta., **7**, Nos. 9–10, p. 152, figs. (adult, puparium). Cleveland, 1922, Purdue Univ. Dept. Agric., Ext. Bull. **105**, p. 4 (1940, 1945, revised by Davis). Hall, 1928, U.S. Dept. Agric., Misc. Publ. **25**, p. 8, fig. 13. Rawson, 1934, Scientific Mo., **39**, p. 504. Babcock, 1938, Ann. Rept. Texas Agric. Expt. Sta., **50**, (for 1937), p. 272. McDonald, 1940, Iowa Agric. Expt. Sta., Bull. **P-4**, p. 177. Stuckey, 1940, Ann. Rept. Georgia Expt. Sta., **52**, (for 1939–1940), p. 48; 1941, *Op. cit.*, **53**, (for 1940–1941), p. 78; 1942, *Op. cit.*, **54**, (for 1941–1942), p. 51; 1943, *Op. cit.*, **55**, (for 1942–1943), p. 29. Hagan, 1943, Infectious Diseases Domestic Animals, p. 392 (*Trypanosoma melophagium*). Smith and Kelly, 1943, Jl. Kansas Ent. Soc., **16**, p. 3; 1944, *Op. cit.*, **17**, p. 95. Kelly, 1944, Kansas Farmer, **81**, No. 8, p. 22. Stuckey, 1944, Ann. Rept. Georgia Expt. Sta., **56**, (for 1943–1944), p. 38; 1945, *Op. cit.*, **57**, (for 1944–1945), p. 36. Smith and Kelly, 1945, Jl. Kansas Ent. Soc., **18**, p. 93. Miller, 1945, U.S. Dept. Agric., Rept. Bur. Anim. Ind., (for 1944–1945), p. 34. Shull, Holm and Manis, 1945, Univ. Idaho, Ext. Circ. 88, p. 2 (revised: 1946, Circ. **92**, p. 2). Simms, 1946, U.S. Dept. Agric., Rept. Bur. Anim. Ind., (for 1945–1946), pp. 2 and 48. Smith, Dean, and Kelly, 1946, Jl. Kansas Ent. Soc., **19**, p. 50. Stuckey, 1946, Ann. Rept. Georgia Expt. Sta., **58**, (for 1945–1946), p. 48; 1947, *Op. cit.*, **59**, (for 1946–1947), p. 49. Bear, 1947, Ohio Farmer, **199**, No. 12, p. 13. Smith, Dean and Kelly, 1947, Jl. Kansas Ent. Soc., **20**, pp. 55 and 58. Kammlade, 1947, Sheep Science, p. 470. Dicke, Morgan and Pope, 1948, Ann. Rept. Univ. Wisconsin Expt. Sta., Bull. **474**, p. 15. Welch, 1949, Montana Wool Grower, **23**, No. 3, p. 6. Schwardt, 1950, Ann. Rept. Coll. Agric. Cornell Univ., **62**, (for 1949), p. 146. Rogoff, 1950, Rept. South Dakota Agric. Expt. Sta., **63**, p. 126. Hill, Hixson, and Muma, 1950, Ann. Rept. Nebraska Agric. Expt. Sta., **63**, p. 78. Cox, Bell, and Reed, 1951, Kansas Agric. Expt. Sta., Bull. **348**, p. 72. (Anonymous), 1951, Wisconsin Agric. Coll. Ext. Spec. Circ., pp. 1–4. (Anonymous), 1951, U.S. Dept. Agric., Agr. Res. Admin., Leafl. **308**, p. 3, fig. Knowlton, Keetch, and Binns, 1952, Utah State Agric. Coll., Ext. Circ. **156**, p. 1, fig. Knipling, 1952, U.S. Dept. Agric., Yearbook for 1952, "Insects," p. 665. MacNay, 1952, Ann. Rept. Ent. Soc. Ontario, **82**, (for 1951), p. 111 (British Columbia). Dunlap, 1953, Washington State Coll., Dept. Anim. Husb., Stockmen's Handb., p. 76. Price and Rodriguez, 1953, Kentucky Agric. Coll., Ext. Circ. **477**, p. 8. Brannon, 1954, Washington State Coll., Dept. Anim. Husb., Stockmen's Handb., p. 109. Nelson, 1955, Jl. of Parasitology, **41**, p. 635 (artificial feeding through animal membranes). Roselle, 1956, Univ. Nebraska Coll. Agric., Ext. Circ. **56**, p. 4.

Distribution and Additional Records (since 1942). Alaska (recorded by Ferris and Cole, 1922, at the Yukon Boundary; J. Bequaert, 1942).

Dominion of Canada. Alberta (recorded by Strickland, 1938; Gwatkin, Painter and Moynihan, 1942). — British Columbia

(recorded by Spencer, 1938; J. Bequaert, 1942; MacNay, 1952; Gregson, 1953): Kamloops (G.B. Rich. — According to Mr. Rich, *in litt.*, 1952, throughout British Columbia wherever sheep are maintained, certainly as far north as Vavenby, about 51° 40′ N., 119° 45′ W.). — Ontario (recorded by J. Bequaert, 1942). — Quebec (recorded by Winn and Beaulieu, 1932; Whitehead, 1942; J. Bequaert, 1942; Chagnon, 1952).

United States. Arizona: Toreva, Navajo Co.; Fort Defiance, Apache Co. — Arkansas: Blytheville, Mississippi Co. — California (recorded by J. Bequaert, 1942): Lakeport, Lake Co. (L.C. Barnard); Topaz, Mono Co. (J.L. Webb); Taylorsville, Plumas Co. (C. Curtice); Kelseyville, Lake Co. (W.G. Upton); Palo Alto, Sa. Clara Co. (W.J. Jellison); Alkali Lake, Modoc Co. (F.C. Bishopp). — Colorado (recorded by Stiles, 1901; Hall, 1912; J. Bequaert, 1942): Colorado Springs (M.C. Hall); Amo, El Paso Co. (M.C. Hall); Resolis, Elbert Co. (M.C. Hall). — Connecticut (recorded by Johnson, 1925; J. Bequaert, 1942): Essex, Middlesex Co. (W.E. Britton). — Delaware: Nassau, Sussex Co. (D. MacCreary). — District of Columbia (recorded by J. Bequaert, 1942). — Idaho: Martin, Butte Co. (M.D. Martin); Clawson, Teton Co. (J. Heurle); Malad City, Oneida Co. (D.C. Ray); Sunnyside, Elmore Co. (E.N. Raymond); Camas, Jefferson Co. (A.H. Ulric); Bellevue, Blaine Co. (O.J. Allen). — Illinois (recorded by McCauley and Russell, 1940; J. Bequaert, 1942): Antioch, Lake Co.; Milford, Iriquois Co. (H. Duis); Decatur, Macon Co. (R.B. Peverly); Avon, Fulton Co. (W.F. Rapp). — Iowa (recorded by J. Bequaert, 1942). — Kansas (recorded by J. Bequaert, 1942). — Kentucky (recorded by J. Bequaert, 1942). — Louisiana: Washington Parish (E.S. Tucker). — Maine (recorded by Johnson, 1925; Procter, 1938; J. Bequaert, 1942): Bangor, Penobscot Co. (L.S. Lippincott); Lake Shore, Kennebec Co., on local sheep, 1946 (McTaggart). — Maryland (recorded by J. Bequaert, 1942): Hyattsville, Prince Georges Co. (R.T. Habermann); Beltsville, Prince Georges Co. (Underwood); Bethesda, Montgomery Co. (Foster); Norbeck (J.W. Davis). — Massachusetts (recorded by Johnson, 1925; J. Bequaert, 1942): Martha's Vineyard, on local sheep of two farms, November, 1941 (C.N. Smith and M.M. Cole); Rochester, Plymouth Co. (C. Mathews); Naushon I., Dukes Co. (F.C. Bishopp). — Michigan (recorded by J. Bequaert, 1942): Ann Arbor, Washtenaw Co. (R.M. Bailey). — Minnesota (recorded by Washburn, 1905; J. Bequaert, 1942). — Mississippi: Calyx, Noxubee Co. (C.S. Field);

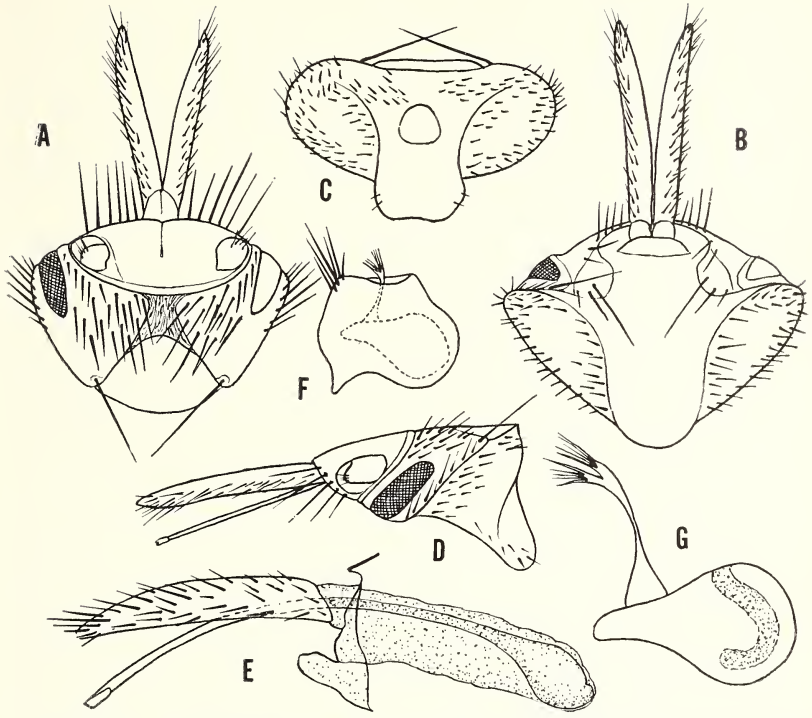

Fig. 104. *Melophagus ovinus* (Linnaeus). **A-D**, head, ♂, Bogotá, Colombia, from above (**A**), below (**B**), behind (**C**), and in side view (**D**); **E**, palpi and partly retracted mouth-parts, ♂, from the side; **F**, antenna removed from pit, ♂; **G**, 3rd antennal segment and arista, removed from 2nd segment, ♂.

Holly Springs, Marshall Co. (T.F. McGehee). — Montana (recorded by Seghetti and Firehammer, 1950; J. Bequaert, 1942): French Basin, Ravalli Co. (W.L. Jellison); Jeffers, Madison Co. (C. Carlson); Lolo, Missoula Co. (W.V. King); Silverton (L. Dern). — Nebraska (recorded by Swingle, 1909): North Platte, Lincoln Co. (Donna Peterson). — Nevada (recorded by J. Bequaert, 1942). — New Hampshire (recorded by Johnson, 1925; J. Bequaert, 1942): Sandwich, Carroll Co.; Lancaster, Coos Co.; Bedford, Manchester Co. (F.M. Crowell). — New Jersey (recorded by Johnson, 1900, 1910): Morristown, Morris Co. (A.F. Ohnsted). — New Mexico (recorded by Austen, 1906; J. Bequaert, 1942): Pecos, San Miguel Co. (T.D.A. Cockerell); Jicarilla Apache Reservation, Lincoln Co. (S.W. Wiest). — New York (recorded by Pratt, 1899; Felt, 1900; Leonard, 1928; J. Bequaert, 1942):

Montauk Point, Long Island; Hamilton Co. (J. Heller); Herkimer, Herkimer Co. (F.C. Bishopp); [Stony and Falleo Is., Lake Ontario, Jefferson Co.; Gorham, Ontario Co.; Logan, Monterey and Mecklenburg, Schuyler Co.; Belfast, Allegany Co.; North Collins, Erie Co.; vicinity of Ithaca, Tompkins Co.; all on local sheep; according to H.H. Schwardt, *in litt.*, 1941; specimens not seen]. — North Carolina (recorded by Brimley, 1938): Farmington, Davie Co. (C.S. Brimley). — Ohio (recorded by Mote, 1914, 1922; J. Bequaert, 1942): Duncan Falls, Muskingum Co. (P.R. Lowry). — Oklahoma (recorded by J. Bequaert, 1942). — Oregon (recorded by Cole and Lovett, 1921; J. Bequaert, 1942): Dayville, Grant Co., on *Odocoileus h. hemionus* (Stage-Hendricks; one specimen, at U.S.Nat.Mus.); Grass Valley, Sherman Co.; Independence, Polk Co. (R.H. Nelson); Adel, Lake Co. (F.C. Bishopp). — Pennsylvania (recorded by Pratt, 1899; Haimbach, 1907; J. Bequaert, 1942). — Rhode Island: Kingston, Washington Co. (received from H. Knutson). — South Dakota: Aberdeen, Brown Co., on a hog (W.E. Dove). — Texas (recorded by Babcock and Parish, 1936; J. Bequaert, 1942; Hedeen, 1953): Kerrville, Kerr Co. (J.D. Mitchell). — Utah (recorded by Knowlton, Harmston and Stains, 1939; J. Bequaert, 1942): Price, Carbon Co. (Stewart); Cove, Cache Co. (H.H. Allen); Falcon (H.E. Sweetman); Salina, Sevier Co. (M.A. Freece); Snowville, Box Elder Co. (J.J. Larkin); Promontory, Box Elder Co. (F.C. Bishopp); Mendon, Cache Co. (J. Baker). — Vermont: Brattleboro, Windham Co. — Virginia (recorded by J. Bequaert, 1942): Vienna, Fairfax Co. (E.A. Chapin). — Washington (State) (recorded by Hatch, 1938; J. Bequaert, 1942): Fruitland, Stevens Co. (J.S. McLean); Clallam Co. (G. Docker); Winona, Whitman Co. (A. Aanestad; J. Lamb). — West Virginia (recorded by Hopkins, 1891). — Wisconsin (recorded by MacArthur, 1948): Sun Prairie, Dane Co. (Helen S. Renk); Madison (W.C. Campbell); Waukesha Co. — Wyoming (recorded by Swingle, 1913): Hudson, Fremont Co. (J.N. Davis); Waltman, Natrona Co. (F.C. Bishopp); Oil City (R. Grieve).

Mexico (recorded by Rondani, 1879; de Buen, 1950): Mexico City, D.F. (S.J. Bonansea); Jalapa, State Vera Cruz, 1922; Chapingo, State Mexico, on sheep and goat (Mrs. Ana María de Buen de Biagi, F. Biagi, E. Freyermuth, and P. Rojas).

Panama (recorded by J. Bequaert, 1942).

Colombia (recorded by Dunn, 1929; Reyes, 1938, 1947, 1948; Patiño-Camargo, 1940; J. Bequaert, 1942).

Venezuela (recorded by Vogelsang, 1939; Ballou, 1945; Gallo and Vogelsang, 1951).

Ecuador (recorded by Becker, 1919; J. Bequaert, 1942; León and Castillo de León, 1953).

Peru (recorded by Brues, 1915; Gaiger, 1917; Willie, Ocampo, Wederbauer, and Schofield, 1937, 1939; Watson, 1949).

Bolivia (recorded by Torregiani, 1949, 1919; Bau, 1930; J. Bequaert, 1942).

Brazil (recorded by Pinto, 1933; Corrêa, 1952): Belem, Pará, Jan. 22, 1952 (J.A. Munro) [presumably on freshly imported sheep].

Uruguay (recorded by Rubino and Calzada, 1940).

Argentina (recorded by Wolffhügel, 1911, 1912; Werneck, 1935; Girotto, 1940; Roveda and Ringuelet, 1947; Ringuelet, 1948): Gonzalo, Dept. Trancas, Prov. Tucumán, 1300 m. (J.P. Bellomo); Hualfín, Prov. Catamarca (S. Pierotti).

Chile (recorded by Philippi, 1886; Reed, 1904; Edwards and Shannon, 1927; J. Bequaert, 1942, 1951; Stuardo, 1946; Tagle, 1953): Castro, Chiloë I. (F. and M. Edwards and R.E. Shannon); Mocha I. (D.S. Bullock); the locality "Puren," given in 1942, should be "Puven."

Tristan da Cunha (recorded by Crichton, 1951).

Falkland Islands: Douglas Station, on sheep (W.P. Schmit).

Although there are as yet no definite records, *M. ovinus* probably occurs on sheep kept locally in Yukon Territory, Saskatchewan, Manitoba, New Brunswick, Nova Scotia, North Dakota, Indiana, and Tennessee; possibly also in Greenland. In South Carolina, Georgia, Florida, and Alabama its occurrence is more doubtful. Farther south it may be expected in the highlands of Guatemala and Costa Rica, from where there are no precise records thus far.

On the American continent, the sheep-ked breeds at present on locally raised sheep from about 64° N., in Alaska, to about 45° S., in Patagonia and Chile; but it is found farther south in the Falkland Islands (close to 52° S.). In the Andes it ascends to 11,000 ft. It is generally absent from the tropical lowlands, even when sheep are kept there. Although it may be observed there temporarily on sheep newly imported from infested areas, it does not become established.

There is no conclusive proof that *M. ovinus* is established permanently in the Antilles. A specimen at the U.S. National Museum is labelled Mayagüez, Puerto Rico (W.V. Tower), and Beatty (1947) cites the sheep-ked from the island of St. Croix.

Both records were almost certainly temporary introductions, based on specimens taken from sheep newly imported from outside the Antilles. Van Volkenberg (1939) definitely states that he failed to find it in Puerto Rico.

Bionomics. These are discussed in my Monograph (1942*a*, pp. 186–189) and in various sections of Part I of the present work. The only known normal breeding hosts of *M. ovinus* are domestic sheep and perhaps domestic goats. The true original wild host is actually unknown (Pt. I, pp. 310–312). In North America, as elsewhere, it occurs sometimes on domestic sheep gone feral and may pass from these temporarily to other hosts, such as possibly native wild sheep, mule deer, Alaskan wolf, and coyote. Occasionally it is found also on cattle, horse and even Man, all of which are abnormal hosts. Wolffhügel (1912, p. 462) reported an additional case of attack on Man in Argentina, not mentioned in Pt. I (p. 338).

The original descriptions of *Hippobosca ovina* Linnaeus and of its synonyms are copied in my Monograph (1942*a*). Linnaeus actually saw specimens of the sheep-ked, which he described or mentioned from Sweden in his earlier works (1747, 1748, 1754; cited in my 1942 Monograph). He also included it in the 2nd Edition of the Fauna Suecica (1761, p. 472), where he stated that it was more fully described in his "It. W: gothico" [1747, *Wästgöta Resa Foerrattad* 1746, p. 59]. Dr. F. Bryk wrote me (June, 1950) that there are now no Linnaean specimens of *M. ovinus* in any Swedish collection.

Some years ago I mentioned the use of the dog-fly, *Hippobosca longipennis*, in early Chinese medicine (J. Bequaert, 1939*b*, p. 81). Strange popular remedies are, however, by no means the monopoly of the Far East. Quecke (1951) has written an entertaining account of the former and present use of sheep-keds and lice as popular remedies. In certain rural districts of Germany, keds are to this day sometimes given by mouth to cure infectious jaundice (icterus or Weil's disease). As an amusing sidelight on the prevailing entomophobia, the "ked cure" is so loathsome to the patient that it is usually administered without his knowledge. At least one German physician (Rausch, 1948) went to the trouble of testing the possible therapeutic effects by treating 5 cases of jaundice with alcoholic extract of crushed keds. He even reported that the treatment seemed to improve some of the cases. His German colleagues were, however, more sceptical, as appears from an interesting controversy in the German medical literature (Bogendörfer, 1949, 1950; Hausmann, 1950; Münch, 1950; Rausch, 1949; Wigand and Hente, 1950; Wilms, 1950).

REGIONAL DISTRIBUTION IN AMERICA

The main features of the world distribution of the Hippoboscidae were discussed at some length in an earlier section of Part II (pp. 24–38). It may nevertheless be useful to review them in so far as they concern more particularly the New World.

A total of 47 species, belonging to 13 genera of the 3 subfamilies Ornithoicinae, Ornithomyiinae and Melophaginae, are now definitely recognized in the Americas. This compares with a total for the World of approximately 130 species, described and accepted as distinct to date, placed in 20 genera and 6 subfamilies.

Of the 47 American species, 41 are bird-flies and 6 mammal-flies. Three species, *Pseudolynchia canariensis, Lipoptena cervi* and *Melophagus ovinus,* should be omitted from further discussion, as they were introduced by Man within the past 2 or 3 centuries. This leaves 44 autochthonous (or native) hippoboscids, 40 of which occur on birds and 4 on mammals. As the global total of 130 species comprises 95 bird-flies and 35 mammal-flies, the percentage of mammal-flies in America (8 per cent) is far below that for the World as a whole (26 per cent).

Eight of the 44 autochthonous American flies occur under natural conditions in the Eastern Hemisphere also, all of these being bird-flies. One of them, *Ornithomyia fringillina,* is Holarctic. The remainder are more cosmopolitan, either occurring primarily on land birds (*Ornithoica confluenta, Lynchia nigra, L. albipennis,* and *Olfersia fumipennis*) or being restricted more to oceanic birds, mainly within the Tropics (*Olfersia spinifera, O. aenescens,* and *O. fossulata*).[66]

The number of American hippoboscids thus dwindles to 36 strictly precinctive species, of which 32 live on birds and 4 on mammals. On the other hand, 86 native precinctive flies are now recognized in the Old World, 55 on birds and 31 on mammals. The relative poverty of the New World hippoboscid fauna is shown also by the few genera peculiar to that area (3 in all: *Stilbometopa, Microlynchia* and *Neolipoptena*). In sharp contrast, in the Old World 8 of 17 genera (*Ornitheza, Stenepteryx, Hippobosca,*

[66] *Lynchia nigra* is here retained provisionally among the cosmopolitan species because of the reported two occurrences in Hawaii and Queensland; but both these records should be confirmed. Contrary to my earlier conclusion (Part II, pp. 316, 322, 323 and 329), the African *Lynchia dukei* Austen is specifically distinct from *L. nigra,* and there is at present no reliable evidence that the latter occurs in Africa.

Allobosca, Ortholfersia, Austrolfersia, Echestypus and *Melophagus*) and 3 of the 6 subfamilies (Hippoboscinae, Alloboscinae and Ortholfersiinae) are precinctive.

The superiority of the Old World in the Recent hippoboscid fauna, clearly shown by the foregoing figures, is in my opinion an actual fact. It does not merely reflect incomplete knowledge, but will only be enhanced by future investigations, as the louse-flies of the New World are at present much better known than those of the Old. It may be explained to a large extent by the preponderance of the mammal-flies, itself correlated with the rich Recent mammalian fauna of the Old World. As pointed out in Part I (p. 286), the order Artiodactyla, nowadays more abundant in Africa than elsewhere, contains more breeding hosts of Hippoboscidae and harbors more species of such flies than all other mammals combined. This order is poorly represented in the Recent American fauna. There is, however, no such ready explanation for the evident, albeit lesser, numerical superiority of the Old World bird-flies over those of the New, especially since the Neotropical bird fauna is richer and more varied than that of the Paleotropics. It may be due in part to the fact that certain orders or families of birds, with many genera and species in the American Tropics, contain no, or few, true breeding hosts of hippoboscids. Many or most Psittaciformes, Trogoniformes, Piciformes, Trochilidae, Formicariidae, Furnariidae, Cotingidae, and Thraupidae are seemingly avoided by these flies. Nevertheless I suspect that the difference may have a deeper, perhaps historical cause; but I know of no factual evidence that could be brought to bear on the problem.

The subjoined regional lists of the flies known at present from each of the major political entities of the New World (and from the provinces and states of Canada and the United States), were compiled for the convenience of local entomologists. They are of little general interest, except that they bring out the many gaps in our present knowledge of the geographical distribution and should warn us not to attempt a too detailed analysis of the available data. In North America, where the Hippoboscidae have been most thoroughly investigated, presumably few species will be added to those listed from Alaska, the Dominion of Canada, the United States, or even Mexico. Within the United States, however, few if any of the states could claim to be completely known. Texas now leads the list with 14 species, followed by Massachusetts (13), New York (12), Pennsylvania (12), Wisconsin (12), Kansas (11),

Florida (11), and California (11); but additional species will no doubt be discovered in the future in nearly every one of these states. For most of the other states the lists are a mere beginning. The situation is far less satisfactory for the remainder of Central America, the Antilles and South America. Brazil leads here with 30 species (more than the total known from the United States, a much better collected area), followed by Venezuela (22), Panama (21), Colombia (19) and Argentina (14); but, again, additions will certainly be made in every case.

In spite of such obvious deficiencies, the major features of the American hippoboscid fauna are now sufficiently known to attempt an analysis along the broad lines of the classical zoogeographical divisions. Those adopted here are: (1) the Nearctic Region, north of the Tropic of Cancer (23° 27′ N.); (2) the Neotropical Region, between the Tropics, including the Antilles; and (3) what will be called here the Neantarctic Region, south of the Tropic of Capricorn (23° 27′ S.).[67]

1. **Nearctic Region.** Although the Nearctic biota has, as a whole, much in common, factually as well as historically, with that of the Palearctic Region, there is little evidence of this among the Hippoboscidae. The 25 autochthonous Nearctic louse-flies comprise four geographical elements: (*a*) one Holarctic species, *Ornithomyia fringillina;* (*b*) 5 species likewise of the Old World, but more widespread there and at home in tropical rather than in temperate areas; (*c*) 14 essentially Neotropical species, which extend their range, either normally or accidentally, north of the Tropic of Cancer; and (*d*) 5 strictly Nearctic, precinctive species, *Myiophthiria fimbriata, Stilbometopa impressa, Lynchia hirsuta, Neolipoptena ferrisi,* and *Lipoptena depressa.* Thus the Nearctic

[67] The relatively small area of temperate South America, south of the Tropic of Capricorn, is customarily treated as a subdivision of the Neotropical Region, the so-called Chilian Subregion; and the corresponding extratropical parts of South Africa (South African Subregion) and of Australia (Australian Subregion) are similarly subordinated to the Ethiopian and Australian Regions. It would seem more in accordance with the facts, as well as more convenient in discussion, to group all temperate areas south of the Tropic of Capricorn in one Holantarctic Realm, the counterpart of the Holartic Realm of the Northern Hemisphere. This could then be divided into a Neantarctic, an Afroantarctic and an Austroantarctic Region.

hippoboscid fauna shows few affinities with that of the Palearctic Region. It also has little individuality. More than half of the species appear to be relatively recent invaders, which probably entered the Region mainly from the American Tropics, after the last Ice Age.

The foregoing analysis brings out once more that the Hippoboscidae are essentially tropical and subtropical insects, as I stressed before (Part I, p. 121; Part II, p. 36). If the records of the Nearctic louse-flies are arranged in zones according to latitude, it is found that the number of species decreases steadily from south to north. The southmost zone, between the Tropic of Cancer and 40° N., comprising the southern half of the United States and a small adjoining area of northern Mexico, harbors 24 of the 25 known Nearctic species. In the zone between 40° N. and 50° N., including approximately the northern half of the United States, a narrow southern strip of Canada, as well as the Maritime Provinces, the number decreases to 21, including 3 species found only west of the 100th Meridian. Moreover, there is a further decrease in the northmost section of this zone, as only 12 autochthonous species are known from the whole of the Dominion of Canada. In the vast continental area north of 50° N., most of the very few reported hippoboscids are accidental captures; there is probably only one truly native species, the widespread, but strictly Holarctic *Ornithomyia fringillina*. This has been taken as far north as 68° N., slightly beyond the Arctic Circle, and is the only native louse-fly reported from Alaska. As this fly occurs nowhere within the Tropics, it appears to have reached the New World by natural means by a northern route, presumably from northern Asia across Bering Strait, after the final retreat of the Ice.

In connection with the historical development of the fauna, it may be of some interest that the Nearctic hippoboscids are not all uniformly distributed from east to west across the continent. The 5 precinctive Nearctic species listed above are all restricted to the western half of the United States. On the other hand, 8 of the species known from the eastern United States have never been taken in the western half of the continent; these are all widespread Neotropical flies, which presumably extended their range northward through the humid southeastern states, but were unable to do so in the arid or semi-arid southwestern sections.

It should also be noted that, of the 5 cosmopolitan and of the 14 Neotropical flies recorded from the Nearctic Region, some scarcely qualify as true permanent members of the local fauna.

Ornithoica confluenta (1 Florida record), *Stilbometopa fulvifrons* (1 New Jersey record), *Olfersia spinifera* (2 Florida and Louisiana records) and *O. bisulcata* (3 Texas records) are so rarely recorded that they are not much more than accidental visitors. Even some of the more frequently captured flies, such as *Ornithoctona fusciventris*, *Stilbometopa podopostyla*, *Lynchia angustifrons*, *L. albipennis* and *L. holoptera*, are perhaps only summer residents, being unable to survive the winter, either as adults or as puparia, at least in the more northern sections of the United States and in Canada.

2. **Neotropical Region.** The 37 recognized, autochthonous Neotropical hippoboscids (35 bird-flies and 2 mammal-flies) are a more homogeneous lot than that of the Nearctic Region. Only the 7 cosmopolitan species listed above are an extraneous element. Three of the 7 may, moreover, be disregarded, as they are restricted to oceanic birds. Two others are world-wide parasites of waders (Ciconiiformes) and one is the specific parasite of the cosmopolitan osprey. This leaves *Lynchia nigra*, clearly a fly of Neotropical origin, but which is perhaps now extending its range by natural means to parts of the Old World.

Of the remaining 30 Neotropical flies, only 15 are strictly precinctive in the American Tropics; 14 extend, either normally or casually, to the Nearctic Region, while 10 have been reported from the Neantarctic Region. As a result, the following 11 species, or 25 per cent of all native American hippoboscids, are known to occur on the Continent from the United States or from southern Canada to Argentina. Except for *Lipoptena mazamae*, they are bird-flies.

Ornithoica vicina, from 50° N. to 41° 30′ S.
Ornithoctona erythrocephala, from 56° N. to 33° S.
" *fusciventris*, from 45° 30′ N. to 27° or 28° S.
Lynchia americana, from 49° N. to 30° S.
" *angustifrons*, from 46° N. to 27° S.
" *wolcotti*, from 46° 20′ N. to 27° 11′ S.
" *nigra*, from 56° 40′ N. to 28° S.
Microlynchia pusilla, from 46° 50′ N. to 25° 30′ S.
Pseudolynchia brunnea, from 48° 35′ N. to 41° S.
Olfersia bisulcata, from 29° 15′ N. to 23° 10′ S.
Lipoptena mazamae, from 33° 30′ N. to 27° 30′ S.

Very few other families of insects have as high a percentage of species with a comparable wide latitudinal range. The explanation for the unusual wide distribution of many hippoboscids is,

however, not far to seek. Each of the species listed above is either a pleioxenous or a polyxenous parasite (Part I, pp. 320 and 322), with a variety of suitable breeding hosts available over most of the American continent.

The extension of these flies to extratropical areas does not actually detract from the individuality of the Neotropical hippoboscid fauna. The important fact remains that the Neotropics have nowadays very few louse-flies in common with the Paleotropics, which are likewise the headquarters of these parasites in the Old World. The main reason for this is no doubt that a similar condition prevails for the birds, the leading hosts of the flies, particularly in the New World. The American bird fauna is characterized by several numerically important precinctive families, such as the Tinamidae, Cathartidae, Cracidae, Meleagridae, Trochilidae, Ramphastidae, Formicariidae, Furnariidae, Cotingidae, Tyrannidae, Vireonidae, Thraupidae, and Icteridae. Birds of these families are not only frequently infested with flies, but some of them are the only true breeding hosts of certain species. The Old World fauna in turn has a number of peculiar families of birds, which commonly serve as hosts for flies, such as the Struthionidae, Otitidae, Pteroclidae, Musophagidae, Coraciidae, Meropidae, Bucerotidae, Pittidae, Alaudidae, Pycnonotidae, Campephagidae, Meliphagidae, Ploceidae, Sturnidae, Oriolidae, and Dicruridae. In view of the small number of American mammal-flies, the fundamental differences between the Old World and the New World birds account sufficiently for their distinctive hippoboscid faunae. In each of these areas the evolution of the bird-flies obviously followed that of the birds. It might therefore be interesting to determine at approximately what time in geological history the two bird faunae started to diverge. Unfortunately there seems to be at present little factual evidence bearing on the matter, so that further speculation would be most hazardous.

The majority of the 30 autochthonous Neotropical flies are fairly uniformly distributed and the gaps in their ranges are mostly due to fragmentary knowledge. Three species are known thus far only from west of the Isthmus of Panama (*Ornithomyia hoffmannae, Ornithoctona orizabae* and *Microlynchia furtiva*) and 6 only from east of the Isthmus (*Ornithomyia ambigua, Crataerina seguyi, Myiophthiria neotropica, Ornithoctona oxycera, Microlynchia galapagoensis* and *Lipoptena guimaraesi*). It would be premature, however, to use these more localized flies as a valid argument for marking the Isthmus of Panama as a special zoogeo-

graphical boundary. They are bird-flies, with one exception, and mostly known at present from one or a few records, so that future collecting may extend their ranges greatly. The one mammal-fly, *L. guimaraesi*, is presumably a specific parasite of pampas deer (*Ozotoceros bezoarticus*), so that it will be restricted to the limited range of its host, from Bolivia and southern Brazil to northern Patagonia.

The far-flung archipelago of the Antilles harbors only a depauperate and commonplace Neotropical hippoboscid fauna. There are no native mammal-flies, owing to the lack of suitable wild hosts, particularly Artiodactyla. All of the 15 recorded bird-flies are known also from the American continent. With one possible exception, they are widespread elsewhere: 3 are oceanic throughout the Tropics (*Olfersia spinifera*, *O. aenescens* and *O. fossulata*); 4 are cosmopolitan on land (*Ornithoica confluenta*, *Lynchia albipennis*, *L. nigra* and *Olfersia fumipennis*); and 7 occur in the Neotropical and usually also in the Nearctic Regions (*Ornithoica vicina*, *Ornithoctona erythrocephala*, *O. fusciventris*, *Stilbometopa ramphastonis*, the oceanic *Olfersia sordida*, *Microlynchia pusilla* and *Pseudolynchia brunnea*). Possibly *Stilbometopa fulvifrons* may be a truly precinctive Antillean fly, as there are only 2 records thus far from the continent, and both appear to be based on accidental strays. Unfortunately the taxonomic status of this species is as yet uncertain, and it may eventually prove to be cospecific with *S. podopostyla*, a fly widely distributed on the continent. The 4 flies of oceanic birds are spread over most of the archipelago; the remaining 11 flies have all been taken in the Greater Antilles (Cuba, Jamaica, Hispaniola and Puerto Rico), but only 2 of them (*Ornithoctona erythrocephala* and *Microlynchia pusilla*) are known thus far from the Lesser Antilles. This is easily explained by the more varied bird fauna of the larger islands, as well as by their being used more extensively and more regularly as a bridge during the seasonal migrations and as winter quarters by many Nearctic birds.

3. **Neantarctic Region.** As compared with the foregoing two areas, the territory south of the Tropic of Capricorn (23° 27′ S.), here included in the Neantarctic Region, is very small. Its bird fauna is, moreover, relatively poor and shows few of the differences from the Neotropics which are such a striking feature of the Nearctic Region. Its Hippoboscidae have also been little investigated thus far, so that substantial additions to the list of the recorded species may be predicted. Omitting the unrecognized

Lynchia penelopes, 18 native louse-flies (17 bird-flies and 1 mammal-fly) are known from the area. It should be stressed that most of these are confined to the northern, warm temperate or subtropical section. Only 5 of the species (*Ornithoica vicina, Ornithomyia parva, Crataerina seguyi, Ornithoctona erythrocephala* and *Pseudolynchia brunnea*) have been taken south of 30° S. Of the 18 species, 17 occur in the Neotropics and 12 of these enter also the Nearctic Region. The hippoboscid fauna has therefore very little individuality. The one precinctive Neantarctic fly, *Ornithomyia parva,* is found on the continent between 26° S. and 39° S., as well as on the islands of Tristan da Cunha and Gough, in the southern Atlantic. This interesting insect is the Antarctic representative of the Holarctic *Ornithomyia fringillina.* The two species are so closely related that they appear to have been derived from a common, presumably extinct and more widespread ancestor. Both have a variety of suitable breeding hosts, but show a predilection for Passeriformes. Is it too far-fetched to assume that their putative common ancestor was likewise a polyxenous parasite?

In some other groups of animals and particularly of insects, the Neantarctic Region, or Chilian Subregion, has produced a wealth of peculiar genera and species, sometimes with overtones of circumpolar, Antarctic affinities. In contrast with these, the Hippoboscidae of temperate South America are a commonplace lot. They offer no tangible evidence in support of any of the current theories on the origin and further evolution of the South American fauna as a whole.

In summary, the main peculiarities of the hippoboscid fauna of the Americas are: (*a*) a relative poverty in species and supraspecific entities, as compared with the Old World; (*b*) a strong predominance of the bird-flies; (*c*) a marked individuality, little influenced by advecticious immigrants from the Old World; and (*d*) its essentially Neotropical character.

In the following list asterisks mark species introduced by Man from the Old World.

Alaska (2): *Ornithomyia fringillina; *Melophagus ovinus.*

Dominion of Canada (13). Alberta (5): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia nigra; L. albipennis; *Melophagus ovinus.* — British Columbia (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia nigra; L. albipennis; Olfersia fumipennis; Neolipoptena ferrisi; Lipop-*

*tena depressa; *Melophagus ovinus.* — LABRADOR (1): *Ornithomyia fringillina.* — MANITOBA (2): *Ornithoctona erythrocephala; Lynchia albipennis.* — NEWFOUNDLAND (1): *Ornithomyia fringillina.* — NOVA SCOTIA (3): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana.* — ONTARIO (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; Pseudolynchia brunnea; *Melophagus ovinus.* — QUEBEC (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. nigra; L. albipennis; Olfersia fumipennis; *Melophagus ovinus.* — SASKATCHEWAN (1): *Ornithomyia fringillina.*

UNITED STATES (27). ALABAMA (3): *Lynchia americana; L. albipennis; *Pseudolynchia canariensis.* — ARIZONA (10): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Stilbometopa impressa; S. podopostyla; Lynchia americana; L. nigra; Microlynchia pusilla; *Melophagus ovinus.* — ARKANSAS (3): **Pseudolynchia canariensis; P. brunnea; *Melophagus ovinus.* — CALIFORNIA (11): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona fusciventris; Stilbometopa impressa; Lynchia americana; L. hirsuta; Microlynchia pusilla; *Pseudolynchia canariensis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — COLORADO (7): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Lynchia americana; L. nigra; *Pseudolynchia canariensis; *Melophagus ovinus.* — CONNECTICUT (7): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; *Pseudolynchia canariensis; *Melophagus ovinus.* — DELAWARE (3): *Lynchia americana; *Pseudolynchia canariensis; *Melophagus ovinus.* — DISTRICT OF COLUMBIA (7): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona fusciventris; Lynchia americana;* (*Microlynchia pusilla*, on imported host); **Pseudolynchia canariensis; *Melophagus ovinus.* — FLORIDA (11): *Ornithoica confluenta; Ornithoctona erythrocephala; Lynchia americana; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. fumipennis; O. sordida; Lipoptena mazamae.* — GEORGIA (7): *Ornithoctona*

*erythrocephala; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Lipoptena mazamae.* — IDAHO (5): *Lynchia nigra; L. hirsuta; Microlynchia pusilla; Lipoptena depressa; *Melophagus ovinus.* — ILLINOIS (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; *Pseudolynchia canariensis; *Melophagus ovinus.* — INDIANA (2): *Lynchia americana; L. albipennis.* — IOWA (8): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; *Melophagus ovinus.* — KANSAS (11): *Ornithoica vicina; Ornithoctona erythrocephala; Stilbometopa podopostyla; Lynchia americana; L. nigra; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Melophagus ovinus.* — KENTUCKY (3): *Ornithoctona fusciventris; Lynchia americana; *Melophagus ovinus.* — LOUISIANA (10): *Ornithoica vicina; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; Olfersia spinifera; O. fumipennis; O. bisulcata; O. sordida; Lipoptena mazamae; *Melophagus ovinus.* — MAINE (5): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; *Melophagus ovinus.* — MARYLAND (10): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; *Pseudolynchia canariensis; P. brunnea.* — MASSACHUSETTS (13): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; L. holoptera; *Pseudolynchia canariensis; P. brunnea; *Lipoptena cervi; *Melophagus ovinus.* — MICHIGAN (10): *Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. wolcotti; L. angustifrons; L. albipennis; Pseudolynchia brunnea; Olfersia fumipennis; *Melophagus ovinus.* — MINNESOTA (10): *Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. nigra; L. albipennis; Pseudolynchia brunnea; Olfersia fumipennis; *Melophagus ovinus.* — MISSISSIPPI (5): *Ornithoctona erythrocephala; Lynchia americana;*

*L. albipennis; *Pseudolynchia canariensis; *Melophagus ovinus.* — Missouri (5): *Ornithoica vicina; Ornithoctona erythrocephala; Lynchia americana; L. angustifrons; L. albipennis.* — Montana (7): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia nigra; L. albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — Nebraska (9): *Myiophthiria fimbriata; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; Lynchia americana; L. wolcotti; L. albipennis; Microlynchia pusilla; *Melophagus ovinus.* — Nevada (5): *Stilbometopa impressa; Lynchia americana; L. hirsuta; *Pseudolynchia canariensis; *Melophagus ovinus.* — New Hampshire (10): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; L. wolcotti; L. angustifrons; L. albipennis; Olfersia fumipennis; *Lipoptena cervi; *Melophagus ovinus.* — New Jersey (10): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa fulvifrons; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; Olfersia fumipennis; *Melophagus ovinus.* — New Mexico (8): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Stilbometopa impressa; Lynchia nigra; Microlynchia pusilla; Pseudolynchia brunnea; *Melophagus ovinus.* — New York (12): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. nigra; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Lipoptena cervi; *Melophagus ovinus.* — North Carolina (8): *Ornithoica vicina; Ornithoctona erythrocephala; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Melophagus ovinus.* — North Dakota (4): *Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; Microlynchia pusilla.* — Ohio (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; L. holoptera; Pseudolynchia brunnea; Olfersia fumipennis; *Melophagus ovinus.* — Oklahoma (3): *Stilbometopa podopostyla; Lynchia albipennis; *Melophagus ovinus.* — Oregon (8): *Ornithoica vicina; Ornithomyia fringillina; Lynchia americana; Olfersia fumipennis; O. sordida; Neolipoptena ferrisi;*

*Lipoptena depressa; *Melophagus ovinus.* —Pennsylvania (12): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. albipennis; L. holoptera; *Pseudolynchia canariensis; Olfersia fumipennis; *Lipoptena cervi; *Melophagus ovinus.* — Rhode Island (2): *Lynchia americana; *Melophagus ovinus.* — South Carolina (7): *Ornithoica vicina; Lynchia americana; L. albipennis; L. holoptera; *Pseudolynchia canariensis; P. brunnea; Lipoptena mazamae.* — South Dakota (5): *Ornithomyia fringillina; Lynchia albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — Tennessee (7): *Ornithoica vicina; Ornithomyia fringillina; Lynchia americana; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis.* — Texas (14): *Ornithomyia fringillina; Stilbometopa podopostyla; Lynchia americana; L. angustifrons; L. nigra; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; O. bisulcata; O. sordida; Lipoptena mazamae; *Melophagus ovinus.* — Utah (7): *Ornithoica vicina; Ornithomyia fringillina; Myiophthiria fimbriata; Lynchia nigra; L. hirsuta; Olfersia sordida; *Melophagus ovinus.* — Vermont (6): *Ornithoica vicina; Ornithomyia fringillina; Lynchia americana; Olfersia fumipennis; O. bisulcata; *Melophagus ovinus.* — Virginia (9): *Ornithoica vicina; Ornithoctona fusciventris; Lynchia americana; L. angustifrons; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Olfersia fumipennis; *Melophagus ovinus.* — Washington (State) (9): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona fusciventris; Lynchia americana; L. nigra; L. albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.* — West Virginia (5): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; Lynchia americana; *Melophagus ovinus.* — Wisconsin (12): *Ornithoica vicina; Ornithomyia fringillina; Ornithoctona erythrocephala; O. fusciventris; Lynchia americana; L. angustifrons; L. nigra; L. albipennis; L. holoptera; *Pseudolynchia canariensis; Olfersia fumipennis; *Melophagus ovinus.* — Wyoming (7): *Ornithomyia fringillina; Myiophthiria fimbriata; Lynchia*

*nigra; L. albipennis; Neolipoptena ferrisi; Lipoptena depressa; *Melophagus ovinus.*

Mexico (28): *Ornithoica vicina; Ornithomyia fringillina; O. hoffmannae; Ornithoctona erythrocephala; O. orizabae; O. fusciventris; O. nitens; Stilbometopa impressa; S. podopostyla; S. legtersi; Lynchia americana; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; L. plaumanni; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. aenescens; O. fumipennis; O. bisulcata; O. sordida; O. coriacea; Neolipoptena ferrisi; Lipoptena mazamae; *Melophagus ovinus.*

Guatemala (10): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. ramphastonis; Lynchia angustifrons; Olfersia bisulcata; O. sordida; O. coriacea; Lipoptena mazamae.*

British Honduras (8): *Ornithoica vicina; Lynchia angustifrons; Microlynchia furtiva; Olfersia fumipennis; O. bisulcata; O. coriacea; O. spinifera; Stilbometopa podopostyla.*

Republic of Honduras (8): *Ornithoctona erythrocephala; O. nitens; Stilbometopa podopostyla; Lynchia americana; L. nigra; L. albipennis; *Pseudolynchia canariensis; Lipoptena mazamae.*

Nicaragua (4): *Ornithoctona erythrocephala; O. nitens; Lynchia angustifrons; Olfersia bisulcata.*

Costa Rica (13): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; O. nitens; Stilbometopa fulvifrons; S. ramphastonis; Lynchia americana; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; Microlynchia pusilla; M. crypturelli; *Pseudolynchia canariensis; Olfersia bisulcata.*

Panama (21): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; O. nitens; Stilbometopa ramphastonis; Lynchia americana; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; Microlynchia crypturelli; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. aenescens; O. bisulcata; O. fossulata; O. sordida; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Cocos Island (2): *Olfersia aenescens; O. fossulata.*

Antilles. Bahamas (8): *Ornithoica confluenta; Ornithoctona erythrocephala; Stilbometopa fulvifrons; Lynchia albipennis; Olfersia spinifera; O. aenescens; O. fumipennis; O. sordida.* — Cuba and Isle of Pines (10): *Ornithoica*

*vicina; Ornithoctona erythrocephala; Stilbometopa fulvifrons; ?S. ramphastonis; Microlynchia pusilla; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. fumipennis; O. sordida.* — Cayman Islands (1): *Olfersia spinifera.* — Jamaica (9): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa fulvifrons; Lynchia nigra; L. albipennis; *Pseudolynchia canariensis; Olfersia spinifera; O. sordida.* — Hispaniola (5): *Ornithoctona erythrocephala; O. fusciventris; Stilbometopa ramphastonis; *Pseudolynchia canariensis; Olfersia sordida.* — Puerto Rico and Mona Island (6): *Ornithoctona erythrocephala; Lynchia albipennis; *Pseudolynchia canariensis; Olfersia spinifera; O. aenescens; O. fossulata.* — St. Croix (7): *Ornithoctona erythrocephala; Microlynchia pusilla; *Pseudolynchia canariensis; Olfersia spinifera; O. aenescens; O. fossulata; O. sordida.* — St. Thomas (3): *Ornithoctona erythrocephala; Microlynchia pusilla; Olfersia sordida.* — Saba (1): *Ornithoctona erythrocephala.* — St. Kitts (2): *Ornithoctona erythrocephala; *Pseudolynchia canariensis.* — Nevis (1): *Ornithoctona erythrocephala.* — Montserrat (1): *Ornithoctona erythrocephala.* — Guadeloupe (1): *Ornithoctona erythrocephala.* — Marie Galante (1): *Ornithoctona erythrocephala.* — Grenada (2): *Ornithoctona erythrocephala; Microlynchia pusilla.* — Dominica (1): *Ornithoctona erythrocephala.* — St. Vincent (1): *Ornithoctona erythrocephala.* — Grenadines (1): *Ornithoctona erythrocephala.* — Barbados (1): **Pseudolynchia canariensis.*

Colombia (19): *Ornithoica vicina; Ornithomyia ambigua; Crataerina seguyi; Ornithoctona erythrocephala; O. fusciventris; O. oxycera; O. nitens; Stilbometopa podopostyla; Lynchia americana; L. latifacies; L. angustifrons; L. albipennis; L. holoptera; Microlynchia pusilla; *Pseudolynchia canariensis; Olfersia bisulcata; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Venezuela (22): *Ornithoica vicina; O. confluenta; Ornithomyia ambigua; Crataerina seguyi; Myiophthiria neotropica; Ornithoctona erythrocephala; O. fusciventris; O. oxycera; O. nitens; Stilbometopa podopostyla; Lynchia angustifrons; L. wolcotti; L. nigra; L. albipennis; Microlynchia pusilla; *Pseudolynchia canariensis; Olfersia fumipennis;*

*O. bisulcata; O. sordida; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Trinidad (4): **Pseudolynchia canariensis; Olfersia bisulcata; O. sordida; Lipoptena mazamae.*

British Guiana (9): *Stilbometopa podopostyla; Lynchia angustifrons; L. nigra; L. albipennis; L. plaumanni; *Pseudolynchia canariensis; Olfersia bisulcata; O. coriacea; Lipoptena mazamae.*

Dutch Guiana (2): *Olfersia coriacea; Lipoptena mazamae.*

French Guiana (2): (*?Lynchia americana*); *Olfersia bisulcata; Lipoptena mazamae.*

Brazil (30): *Ornithoica vicina; O. confluenta; Ornithomyia ambigua; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. ramphastonis; S. legtersi; Lynchia americana; L. latifacies; L. angustifrons; L. wolcotti; L. nigra; L. albipennis; L. holoptera; L. plaumanni; Microlynchia pusilla; M. crypturelli; *Pseudolynchia canariensis; P. brunnea; Olfersia spinifera; O. aenescens; O. fumipennis; O. fossulata; O. bisulcata; O. sordida; O. coriacea; Lipoptena mazamae; L. guimaraesi; *Melophagus ovinus.*

Paraguay (7): *Ornithoica vicina; Stilbometopa podopostyla; Lynchia latifacies; L. angustifrons; L. albipennis; Microlynchia pusilla; Lipoptena mazamae.*

Ecuador (8): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. ramphastonis; Olfersia fossulata; Lipoptena mazamae; *Melophagus ovinus.*

Peru (13): *Ornithoica vicina; Ornithomyia ambigua; Crataerina seguyi; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; Microlynchia pusilla; *Pseudolynchia canariensis;* (*?Olfersia spinifera*); *O. fossulata; O. bisulcata; O. sordida; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Galapagos (7): *Lynchia nigra; L. albipennis; Microlynchia galapagoensis; Olfersia spinifera; O. aenescens; O. fossulata; O. sordida.*

Bolivia (12): *Ornithoica vicina; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; Lynchia americana; L. wolcotti; L. nigra; L. plaumanni; Olfersia bisulcata; O. coriacea; Lipoptena mazamae; *Melophagus ovinus.*

Argentina (14): *Ornithomyia parva; Ornithoctona erythrocephala; O. fusciventris; Stilbometopa podopostyla; S. legtersi; Crataerina seguyi; Lynchia americana; L. wolcotti; L. nigra; L. albipennis; *Pseudolynchia canariensis; P. brunnea; Lipoptena mazamae; *Melophagus ovinus.*

Uruguay (4): *Ornithoctona erythrocephala; *Pseudolynchia canariensis; Lipoptena mazamae; *Melophagus ovinus.*

Chile (9): *Ornithoica vicina; Ornithomyia parva; Crataerina seguyi; Ornithoctona erythrocephala; O. fusciventris; Microlynchia pusilla; Olfersia bisulcata; O. fossulata; *Melophagus ovinus.*

Ascension Island (2): *Olfersia spinifera; O. aenescens.*

Tristan da Cunha (2): *Ornithomyia parva; *Melophagus ovinus.*

Gough Island (1): *Ornithomyia parva.*

Falkland Islands (1): **Melophagus ovinus.*

HOST DISTRIBUTION IN AMERICA

I. Birds

The nomenclature and sequence of the Orders are those of J.L. Peters (1931–1951), whose generic, specific and subspecific names I have accepted, so far as published (Orders 1 to 19 of my list and the Furnariidae, Formicariidae and Rhinocryptidae in the Passeriformes). For the remaining families of song-birds I have usually followed the *A.O.U. Check-List* (4th Ed., 1931) of North American birds. For America south of the Mexican border I have consulted particularly R. Ridgway and H. Friedmann, for Middle America (various *Bulletins of the U. S. National Museum,* 11 parts to date, 1901–1950), and C.E. Hellmayr, B. Conover and C.B. Cory's *Catalogue of Birds of the Americas* (11 parts, published by the Field Museum of Natural History, Chicago, 1918–1949). Moreover, I have received much competent advice from my colleagues at the Museum of Comparative Zoology, the late James L. Peters, Mr. James C. Greenway, Dr. R.A. Paynter, Jr., and Mr. Ludlow Griscom. The limits and sequence of the families are those of Mayr and Amadon (1951). For ready reference the genera within the family and the species within the genus are listed in alphabetical order. The names inserted in square brackets are either synonyms previously used in print for hosts of flies or changes proposed for the forthcoming revised edition of the A.O.U. list; the latter are taken from the "Supplements" published in *The Auk* (since 1944).

The hosts are differentiated down to the subspecies, so far as possible, to conform with the prevailing usage among ornithologists. As no case is known at present where the choice of a host by a hippoboscid is influenced by a subspecific difference, the comparative study of host relations may safely disregard subspecific distinctions. The listing of the subspecies is only of interest as showing to what extent the fly covers the geographical range of a host species.

Only vernacular names in actual use are mentioned. They may sometimes be useful for the correct recognition of the hosts; but too often they are applied so carelessly as to be misleading or meaningless. In addition to the standard Anglo-American names of the *A.O.U. Check-List,* I cite occasionally other names in local use. I have been sparing with Central and South American vernaculars, because of their bewildering variety and the difficulty of ascertaining which of them may be actually useful to the collector of flies. Some names are cited merely because they were used in print or on collectors' labels for hippoboscids. The Mexican vernaculars were taken from H. Friedmann, L. Griscom and R.T. Moore's *Distributional Check-List of the Birds of Mexico* (Part I, 1950), or kindly contributed by Dr. R.A. Paynter from his personal notes in Yucatan and Chiapas. The French vernaculars, taken from P.A. Taverner's *Birds of Canada* (Toronto, 1938), are inserted only for birds regularly occurring in the Province of Quebec.

Louse-flies definitely known or reasonably certain to use a given bird as breeding host, are indicated by "(br)"; the others by "(ac)"; hosts introduced by Man within historic times, either directly or indirectly, are marked with an asterisk in this list and elsewhere in the text.

1. Order Tinamiformes

Tinamidae (Tinamous)

Crypturellus boucardi boucardi (P.L. Selater): *Stilbometopa podopostyla* (br); *Microlynchia furtiva* (br).

Crypturellus obsoletus obsoletus (Temminck); nambú-gauçu in Brazil: *Stilbometopa podopostyla* (br); *Lynchia plaumanni* (?br); *Microlynchia crypturelli* (br).

Crypturellus parvirostris (Wagler); sururina or chororó in Brazil: *Microlynchia crypturelli* (br).

Crypturellus soui panamensis (Carriker): *Ornithoica vicina* (ac); *Microlynchia crypturelli* (br).

Rhynchotus rufescens rufescens (Temminck); perdix or martineta-colorado in Brazil: *Lynchia holoptera* (?ac).

Tinamus solitarius (Vieillot); macuco in Brazil: *Stilbometopa podopostyla* (br); *Olfersia coriacea* (ac).

2. **Order Gaviiformes**

Gaviidae (Loons)

Gavia immer immer (Brünnich); common loon: *Olfersia fumipennis* (ac).

3. **Order Procellariiformes**

Diomedeidae (Albatrosses)

Diomedea irrorata Salvin; Galapagos albatross: *Olfersia aenescens* (br).

4. **Order Pelecaniformes**

Fregatidae (Man-of-war or Frigate Birds)

Fregata aquila (Linnaeus): *Olfersia spinifera* (br).
Fregata magnificens magnificens Mathews: *Olfersia spinifera* (br).
Fregata magnificens rothschildi Mathews; alcatraz in Brazil: *Olfersia spinifera* (br).
Fregata minor ridgwayi Mathews: *Olfersia spinifera* (br).

Phalacrocoracidae (Cormorants)

Phalacrocorax auritus floridanus (Audubon); Florida cormorant: *Olfersia sordida* (br); *Olfersia spinifera* (ac).
Phalacrocorax bougainvillii (Lesson); Peruvian cormorant; guanay: *Olfersia fossulata* (br).
Phalacrocorax gaimardi (Lesson); red-footed cormorant; shag: *Olfersia fossulata* (br).
Phalacrocorax olivaceus olivaceus (Humboldt) [*P. vigua* Vieillot]; shag; biguá in Brazil; corvejón in Mexico: *Olfersia sordida* (br).

Sulidae (Boobies and Gannets)

Sula dactylatra dactylatra Lesson; masked or white-breasted booby: *Olfersia aenescens* (br).
Sula dactylatra californica Rothschild: *Olfersia aenescens* (br).
Sula leucogaster leucogaster (Boddaert); brown booby; *Olfersia aenescens* (br); *Olfersia fossulata* (br).
Sula leucogaster brewsteri Goss; Brewster's brown booby: *Olfersia aenescens* (br).
Sula nebouxii Milne-Edwards: *Olfersia aenescens* (br).
Sula sula sula (Linnaeus); red-footed booby: *Olfersia spinifera* (ac).
Sula sula rubripes Gould; red-footed booby: *Olfersia aenescens* (br).
Sula variegata (Tschudi); Peruvian booby; piquero: *Olfersia fossulata* (br).

Pelecanidae (Pelicans)

Pelecanus occidentalis occidentalis Linnaeus; West Indian brown pelican: *Olfersia sordida* (br).
Pelecanus occidentalis californicus Ridgway; California brown pelican: *Olfersia sordida* (br); *Olfersia fossulata* (br).
Pelecanus occidentalis carolinensis Gmelin; eastern brown pelican: *Olfersia sordida* (br).
Pelecanus occidentalis thagus Molina: *Olfersia fossulata* (br).

5. **Order Ciconiiformes**

Ardeidae (Herons); including Cochleariidae

Ardea cocoi Linnaeus; socó grande, magoarî or garça-parda in Brazil: *Lynchia albipennis* (br).
Ardea herodias herodias Linnaeus: great blue heron: *Lynchia albipennis* (br).
Ardea herodias cognata Bangs: *Lynchia albipennis* (br).

Ardea herodias occidentalis Audubon; great white heron (white phase of great blue heron): *Lynchia albipennis* (br).
Ardea herodias sanctilucae Thayer and Bangs; Espiritu Santo heron: *Lynchia albipennis* (br).
Botaurus lentiginosus (Rackett); American bittern; butor d'Amérique; ateponaztli or tolcomoctli (Náhuatl) in Mexico: *Ornithoctona erythrocephala* (ac); *Lynchia albipennis* (br).
**Bubulcus ibis ibis* (Linnaeus); cattle heron: *Ornithoica confluenta* (br).
Butorides sundevalli Reichenow: *Lynchia albipennis* (br).
Butorides virescens virescens (Linnaeus); eastern green heron: *Ornithoica vicina* (ac); *Lynchia albipennis* (br).
Butorides virescens bahamensis (Brewster): *Ornithoica confluenta* (br); *Lynchia albipennis* (br).
Butorides virescens maculatus (Boddaert): *Ornithoctona erythrocephala* (ac); *Lynchia albipennnis* (br).
Casmerodius albus egretta (Gmelin); American egret; garça-real or acaratinga in Brazil: *Ornithoica confluenta* (br); *Lynchia americana* (ac); *Lynchia albipennis* (br).
Cochlearius cochlearius cochlearius (Linnaeus); boatbill; arapapá in Brazil; papaxque (Náhuatl) in Mexico: *Lynchia albipennis* (br).
Cochlearius cochlearius panamensis Griscom: *Lynchia albipennis* (br).
Dichromanassa rufescens rufescens (Gmelin); reddish egret: *Lynchia albipennis* (br).
Florida caerulea caerulea (Linnaeus); little blue heron; garça-azul in Brazil; axoquen (Náhuatl) in Mexico: *Lynchia albipennis* (br).
Hydranassa tricolor ruficollis (Gosse); Louisiana heron: *Lynchia albipennis* (br).
Ixobrychus exilis exilis (Gmelin); eastern least bittern: *Lynchia albipennis* (br).
Leucophoyx thula thula (Molina) [*Ardea candidissima* Gmelin]; snowy egret; garça-pequena in Brazil; aztatl (Náhuatl) in Mexico: *Ornithoica confluenta* (br); *Ornithoctona erythrocephala* (ac); *Lynchia albipennis* (br); *Olfersia sordida* (ac).
Mesembrinibis cayennensis (Gmelin); caráuna in Brazil: *Lynchia albipennis* (br); *Olfersia coriacea* (ac).
Nyctanassa violacea violacea (Linnaeus); yellow-crowned night heron: *Ornithoctona erythrocephala* (ac); *Lynchia albipennis* (br).
Nyctanassa violacea pauper (Selater and Salvin): *Lynchia albipennis* (br).
Nycticorax nycticorax hoactli (Gmelin) [*N. n. naevius* Boddaert]; black-crowned night heron; savací, guacurú or socó-galinha in Brazil; hoactli (Náhuatl) in Mexico: *Ornithoctona erythrocephala* (ac); *Lynchia albipennis* (br).
Syrigma sibilatrix (Temminck): *Lynchia albipennis* (br).
Tigrisoma lineatum marmoratum (Vieillot); socó-boi in Brazil: *Lynchia albipennis* (br).

Threskiornithidae (Ibises)

Guara [now *Eudocimus*] *alba* (Linnaeus); white ibis: *Lynchia albipennis* (br).
Theristicus caudatus (Boddaert); curicaca in Brazil: *Lynchia albipennis* (br).

Ciconiidae (Storks)

Jabiru mycteria (Lichtenstein); jaburú: *Lynchia albipennis* (br).
Mycteria americana Linnaeus; wood ibis; Jaburú-moleque in Brazil; coyongo or ganso in Colombia; cuapetlauac or cuapetlanqui (Náhuatl) in Mexico: *Lynchia albipennis* (br).

6. Order Anseriformes

Anatidae (Ducks, Geese)

Anas brasiliensis Gmelin [*Nettion brasiliense*]; marreca-ananaî in Brazil: *Lynchia albipennis* (ae).

Anas crecca carolinensis Gmelin; green-winged teal: *Lynchia albipennis* (ae).

Branta canadensis canadensis (Linnaeus); common Canada goose; outarde canadienne: *Ornithoctona erythrocephala* (ae).

7. Order Falconiformes

Accipitridae (Hawks, Eagles)

Accipiter bicolor bicolor (Vieillot); bicolored hawk: *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br).

Accipiter bicolor pileatus (Temminck): *Lynchia nigra* (br).

Accipiter cooperii (Bonaparte); Cooper's hawk: *Ornithoica vicina* (ae); *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (br); *Stilbometopa impressa* (ae); *Lynchia americana* (br); *Lynchia angustifrons* (br).

Accipiter erythrocnemius chionogaster (Kaup); Guatemalan sharp-shinned hawk: *Ornithoctona erythrocephala* (br).

Accipiter erythrocnemius salvini (Ridgway): *Ornithoctona erythrocephala* (br).

Accipiter erythrocnemius venezuelensis Swann: *Ornithoctona erythrocephala* (br).

Accipiter erythrocnemius ventralis Selater: *Ornithoctona fusciventris* (ae).

Accipiter gentilis atricapillus (Wilson); eastern goshawk: *Ornithoctona erythrocephala* (br); *Lynchia americana* (br).

Accipiter gundlachi Lawrence: *Ornithoctona erythrocephala* (br).

Accipiter striatus velox (Wilson); sharp-shinned hawk; épervier brun: *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (br); *Ornithoctona fusciventris* (ae); *Lynchia americana* (br); *Lynchia wolcotti* (br); *Lynchia nigra* (br); *Lynchia albipennis* (ae); *Lynchia angustifrons* (br); *Neolipoptena ferrisi* (ae).

Aquila chrysaëtos canadensis (Linnaeus); American golden eagle; aigle doré; itzcuauhtli (Náhuatl) in Mexico: *Lynchia americana* (br); *Lynchia nigra* (br).

Busarellus nigricollis nigricollis (Latham); fishing buzzard; guaraguao in Mexico: *Ornithoica vicina* (ae); *Lynchia angustifrons* (br).

Buteo brachyurus Vieillot: *Ornithoctona erythrocephala* (br).

Buteo galapagoensis (Gould); Galapagos hawk: *Lynchia nigra* (br); *Microlynchia galapagoensis* (?ae).

Buteo jamaicensis jamaicensis (Gmelin); West Indian red-tailed hawk: *Ornithoctona erythrocephala* (br).

Buteo jamaicensis borealis (Gmelin); eastern red-tailed hawk; buse à queue rousse: *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).

Buteo jamaicensis calurus Cassin; western red-tailed hawk; chiseny (Otomî) in Mexico: *Ornithoica vicina* (ae); *Lynchia nigra* (br).

Buteo jamaicensis costaricensis Ridgway: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).

Buteo jamaicensis umbrinus Bangs: *Ornithoctona erythrocephala* (br).

Buteo lagopus sancti-johannis (Gmelin); American rough-legged hawk; buse pattue: *Lynchia americana* (br).

Buteo lineatus lineatus (Gmelin); northern red-shouldered hawk; buse à épaulettes rousses: *Lynchia americana* (br); *Lynchia angustifrons* (br).

Buteo lineatus alleni Ridgway; Florida red-shouldered hawk: *Lynchia americana* (br).

Buteo magnirostris magnirostris (Gmelin) [*B. m. magniplumis* Bertoni]; insect hawk; indaié, japacanim, or gavião-carijó in Brazil: *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (ae); *Lynchia angustifrons* (br).

Buteo magnirostris argutus (Peters and Griscom): *Ornithoctona erythrocephala* (br).

Buteo magnirostris conspectus (Peters); *Lynchia nigra* (br).

Buteo magnirostris gularis (Schlegel): *Ornithoctona erythrocephala* (br).

Buteo magnirostris insidiatrix (Bangs and Penard): *Ornithoctona erythrocephala* (br).

Buteo magnirostris superciliaris (Vieillot): *Lynchia nigra* (br).

Buteo melanoleucus melanoleucus (Vieillot): aguia-chilena in Brazil; guincho in Mexico: *Ornithoctona erythrocephala* (br); *Ornithoctona oxycera* (?br).

Buteo nitidus micrus (Griscom): *Lynchia nigra* (br).

Buteo nitidus pallidus Todd: *Lynchia nigra* (br).

Buteo nitidus plagiatus (Schlegel); Mexican gray hawk: *Oruithomyia* (*Pseudornithomyia*) *hoffmannae* (?ae); *Lynchia nigra* (br).

Buteo platypterus platypterus (Vieillot); broad-winged hawk; petite buse or buse de Pennsylvanie: *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia wolcotti* (br); *Lynchia angustifrons* (br).

Buteo platypterus antillarum Clark: *Ornithoctona erythrocephala* (br).

Buteo platypterus cubanensis Burns [*B. latissimus* of Cuba]: *Ornithoctona erythrocephala* (br).

Buteo platypterus rivieri Verrill: *Ornithoctona erythrocephala* (br).

Buteo swainsoni Bonaparte; Swainson's hawk: *Lynchia nigra* (br).

Buteogallus anthracinus anthracinus (Lichtenstein); Mexican crab hawk; mixcoacuahtli (Náhuatl) in Mexico: *Lynchia nigra* (br).

Buteogallus anthracinus cancrivorus (Clark); black hawk of St. Vincent: *Ornithoctona erythrocephala* (br).

Chondrohierax uncinatus (Temminck): *Ornithoctona erythrocephala* (br).

Circus cinereus Vieillot: *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br).

Circus cyaneus hudsonius (Linnaeus); marsh hawk; busard des marais; tlocuauhtli or tlacocuauhtli in Mexico: *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).

Elanoides forficatus yetapa (Vieillot); gavião-tesoura or tapena in Brazil: *Ornithoctona erythrocephala* (br).

Elanus leucurus leucurus (Vieillot); white-tailed kite; gavião-peneira in Brazil: *Lynchia angustifrons* (br).

Gampsonyx swainsonii swainsonii Vigors; pearl kite: *Lynchia nigra* (br).

Geranospiza nigra nigra (Du Bus); black frog hawk: *Lynchia nigra* (br).

Haliaëëtus leucocephalus leucocephalus (Linnaeus); southern bald eagle: *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Olfersia fumipennis* (ae).

Heterospizias meridionalis meridionalis (Latham); gavião-caboclo in Brazil: *Lynchia nigra* (br).

Hypomorphnus urubitinga urubitinga (Gmelin); gavião-preto, cauá or cãcã in Brazil: *Ornithoica vicina* (ae); *Lynchia angustifrons* (br).

Hypomorphnus urubitinga ridgwayi (Gurney): *Ornithoctona erythrocephala* (br); *Lynchia wolcotti* (br); *Lynchia angustifrons* (br).

Ictinia plumbea (Gmelin); ota-azul in Colombia; gavião-sauveiro or soví in Brazil: *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br); *Lynchia nigra* (br).

Leucopternis albicollis costaricensis W.L. Sclater: *Lynchia americana* (ae); *Lynchia angustifrons* (br).

Leucopternis polionota Kaup; gavião-pomba in Brazil: *Lynchia nigra* (br).
Leucopternis princeps Sclater: *Ornithoctona erythrocephala* (br).
Odontriorchis palliatus (Temminck): *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (br).
Oroaëtus isidori (Des Murs): *Ornithoctona erythrocephala* (br).
Spizaëtus ornatus (Daudin); apacanim or urutaurana in Brazil; juandeapié in Mexico: *Ornithoctona erythrocephala* (br).
Spizaëtus tyrannus (Wied); tyrant eagle hawk: *Ornithoctona erythrocephala* (br).
Urubitornis solitaria solitaria (Tschudi); southern solitary eagle: *Ornithoctona erythrocephala* (br); *Lynchia wolcotti* (br).

Falconidae (Falcons and Allies)

Caracara [formerly *Polyborus*] *cheriway audubonì* Cassin; Audubon's caracara; quebrantahuesos or qualele in Mexico: *Lynchia nigra* (br).
Caracara [formerly *Polyborus*] *plancus plancus* (J.F. Miller): *Ornithomyia parva* (ac); *Lynchia americana* (ac).
Caracara [formerly *Polyborus*] *plancus brasiliensis* (Gmelin); caracará or carancho in Brazil: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).
Daptrius americanus americanus (Boddaert); South American carrion falcon; comecacao in Spanish-American countries: *Ornithoctona erythrocephala* (br).
Daptrius ater Vieillot: *Lynchia nigra* (br).
Falco columbarius columbarius Linnaeus; eastern pigeon hawk; faucon émérillon: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).
Falco columbarius bendirei Swann; western pigeon hawk: *Ornithomyia fringillina* (ac).
Falco deiroleucus Temminck; Temminck's falcon: *Ornithoctona erythrocephala* (br).
Falco femoralis femoralis Temminck (= *Falco fusco-coerulescens* of authors, not of Vieillot); southern Aplomado falcon; gavião-de-coleira in Brazil: *Ornithoctona erythrocephala* (br).
Falco mexicanus Schlegel; prairie falcon; thotli (Náhuatl) in Mexico: *Lynchia nigra* (br).
Falco peregrinus anatum Bonaparte; peregrine falcon or duck hawk; faucon pélerin: *Ornithoctona erythrocephala* (br); *Lynchia americana* (br); *Lynchia nigra* (br).
Falco sparverius sparverius Linnaeus; eastern sparrow hawk; faucon cresserelle; chia (Mixteco) or titicha (Otomí) in Mexico: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br); *Lynchia angustifrons* (br); *Lynchia albipennis* (ac).
Falco sparverius caribaeorum (Gmelin): *Ornithoctona erythrocephala* (br).
Falco sparverius cinnamominus Swainson: *Lynchia americana* (br).
Falco sparverius dominicensis (Gmelin): *Ornithoctona erythrocephala* (br).
Falco sparverius eidos Peters: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).
Falco sparverius loquaculus Riley: *Ornithoctona erythrocephala* (br).
Falco sparverius peruvianus (Cory): *Ornithoctona erythrocephala* (br).
Herpetotheres cachinnans cachinnans (Linnaeus); southern laughing falcon; acauã in Brazil; guacabó in Colombia: *Ornithoctona erythrocephala* (br); *Lynchia nigra* (br).
Herpetotheres cachinnans chapmani Bangs and Penard: *Lynchia nigra* (br); *Lynchia angustifrons* (br).
Herpetotheres cachinnans queribundus Bangs and Penard: *Lynchia nigra* (br).

Micrastur gilvicollis (Vieillot): *Ornithoica vicina* (ac); *Ornithoctona erythrocephala* (br).
Micrastur ruficollis ruficollis (Vieillot); gavião-caboré in Brazil: *Ornithoica vicina* (ac); *Lynchia americana* (ac); *Lynchia angustifrons* (br).
Micrastur ruficollis zonothorax (Cabanis): *Ornithoctona erythrocephala* (br).
Micrastur semitorquatus naso (Lesson); Central American pied forest falcon: *Ornithoctona erythrocephala* (br); *O. fusciventris* (ac); *Lynchia wolcotti* (br); *Lynchia angustifrons* (br).
Milvago chimachima chimachima (Vieillot); chimango-do-campo in Brazil: *Lynchia nigra* (br); *Lynchia angustifrons* (br).

Pandionidae (Ospreys)

Pandion haliaetus carolinensis (Gmelin); American fishhawk or osprey; aigle-pêcheur or orfraie; gavião-caripira in Brazil: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (ac); *Lynchia americana* (ac); *Lynchia albipennis* (ac); *Olfersia fumipennis* (br).
Pandion haliaetus ridgwayi Mainard; Bahamas osprey: *Olfersia fumipennis* (br).

Cathartidae (New World Vultures)

Cathartes aura aura (Linnaeus); Central American turkey vulture, turkey buzzard, or red-headed vulture: *Lynchia nigra* (ac); *Lynchia angustifrons* (ac); *Olfersia bisulcata* (br).
Cathartes aura jota (Molina): *Ornithoctona erythrocephala* (ac); *Olfersia bisulcata* (br).
Cathartes aura ruficollis Spix; urubú-de-cabeça-vermelha in Brazil: *Lynchia nigra* (ac); *Olfersia bisulcata* (br).
Cathartes aura teter Friedmann; western turkey vulture: *Ornithomyia fringillina* (ac).
Cathartes urubutinga Pelzeln; urubitinga in Brazil: *Olfersia bisulcata* (?br).
Coragyps atratus atratus (Bechstein) [*Catharista urubu* Vieillot]; North and Central American black-headed vulture, black vulture or buzzard; tzopilotl (Náhuatl), lonchi (Mixteco), or zapilote-de-campo in Mexico: *Olfersia bisulcata* (br).
Coragyps atratus foetens (Lichtenstein) [*Catharista brasiliensis* Bonaparte]; South American black vulture; urubú in Brazil; gallinazo, golero, or chulo in Spanish America; cuervo or jote in Argentina; some ornithologists unite this with typical *atratus: Ornithoctona erythrocephala* (ac); *Olfersia bisulcata* (br).
Sarcoramphus papa (Linnaeus); king vulture; rey-de-chombo or cozcacuauhtli (Náhuatl) in Mexico; alguacil or rey-de-goleros in Colombia; urubú-rei in Brazil: *Olfersia bisulcata* (br).
Vultur gryphus Linnaeus; condor: *Olfersia bisulcata* (?br).

8. Order Galliformes

Cracidae (Guans)

Chamaepetes goudotii goudotii (Lesson): *Ornithoctona erythrocephala* (br).
Chamaepetes goudotii sanctae-marthae Chapman: *Ornithoctona fusciventris* (ac).
Crax alberti alberti Fraser [*C. annulata* Todd]; pajuil in Colombia: *Olfersia coriacea* (br).
Crax fasciolata Spix [*C. sclateri* G.R. Gray]: *Olfersia coriacea* (br).
Crax nigra Linnaeus [*C. alector* Linnaeus]; mutum-poranga in Brazil: *Lynchia plaumanni* (?br); *Olfersia coriacea* (br).
Crax rubra rubra Linnaeus [? *C. globicera* Linnaeus]; crested curassow; kambul (Maya) or bolonchan in Mexico: *Olfersia coriacea* (br).

Ortalis canicollis canicollis (Wagler); charata in Argentina: *Stilbometopa legtersi* (?br); possibly also type host of the unrecognized *Lynchia penelopes.*

Ortalis canicollis pantanalensis Cherrie and Reichenberger; aracuá in Brazil: *Stilbometopa ramphastonis* (?br).

Ortalis columbiana caucae Chapman: *Ornithoctona erythrocephala* (br).

Ortalis vetula vetula (Wagler), chachalaca: *Ornithoctona erythrocephala* (br); *Lynchia plaumanni* (?br).

Ortalis vetula pallidiventris Ridgway; chachalaca; chacha, bach (Maya), or chachalacametl (Náhuatl) in Mexico: *Olfersia coriacea* (br).

Ortalis vetula poliocephala (Wagler), chachalaca: *Stilbometopa legtersi* (?br).

Penelope argyrotis argyrotis (Bonaparte): *Ornithoctona erythrocephala* (br).

Penelope argyrotis colombiana Todd: *Ornithoctona erythrocephala* (br).

Penelope montagnii montagnii (Bonaparte): *Ornithoctona erythrocephala* (br).

Penelope purpurascens purpurascens Wagler; bare-throated guan; kosh (Maya) or cojolito in Mexico: *Ornithoctona erythrocephala* (br); *Olfersia coriacea* (br).

Penelopina nigra (Fraser); pajuil in Mexico: *Ornithoctona erythrocephala* (br).

Pipile jacutinga (Spix); jacutinga in Brazil: *Stilbometopa ramphastonis* (br).

Phasianidae (Pheasants, Quail, Fowl); including Tetraonidae

Bonasa umbellus umbellus (Linnaeus); eastern ruffed grouse: *Ornithomyia fringillina* (br); *Lynchia americana* (br).

Bonasa umbellus togata (Linnaeus); Canada ruffed grouse; gélinotte des bois francs: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (br); *Lynchia americana* (br).

Bonasa umbellus umbelloides (Douglas); gray ruffed grouse: *Ornithomyia fringillina* (br).

Bonasa umbellus yukonensis Grinnell; Yukon ruffed grouse: *Ornithomyia fringillina* (br).

Callipepla squamata pallida Brewster; Arizona scaled quail: *Stilbometopa impressa* (?ac); *Microlynchia pusilla* (ac).

Canachites canadensis canadensis (Linnaeus); Hudsonian spruce grouse; tétras des savannes: *Ornithomyia fringillina* (br).

Canachites franklinii (Douglas); Franklin's grouse: *Ornithomyia fringillina* (br).

Centrocercus urophasianus (Bonaparte); sage hen or sage grouse: *Lynchia hirsuta* (br).

Colinus cristatus sonnini (Temminck): *Microlynchia pusilla* (br).

Colinus virginianus virginianus (Linnaeus); eastern partridge, quail or bobwhite: *Ornithomyia fringillina* (ac); *Lynchia americana* (br); *Microlynchia pusilla* (br); [*Stilbometopa fulvifrons,* on introduced birds in Jamaica].

Dactylortyx thoracicus thoracicus (Gambel): *Ornithoctona erythrocephala* (?br).

Dendragapus obscurus obscurus (Say); dusky grouse: *Ornithomyia fringillina* (br).

Dendragapus obscurus fuliginosus (Ridgway); sooty grouse or willow grouse: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (br).

Dendragapus obscurus richardsoni (Douglas); blue grouse, Richardson's grouse: *Ornithomyia fringillina* (br); *Lynchia hirsuta* (br).

**Gallus gallus bankiva* Temminck; domestic fowl: *Ornithoica vicina* (ac); *Stilbometopa podopostyla* (ac); *Stilbometopa impressa* (ac); *Lynchia americana* (ac); *Pseudolynchia canariensis* (ac; introduced).

Lagopus lagopus lagopus (Linnaeus) [including *Tetrao albus* Gmelin]; willow ptarmigan or willow grouse; lagopède des saules; (circumpolar): *Ornithomyia fringillina* (br).

Lophortyx californica californica Shaw [*L. c. vallicola* Ridgway]; California quail: *Stilbometopa impressa* (br); *Lynchia hirsuta* (br).
Lophortyx californica brunnescens Ridgway: *Stilbometopa impressa* (br); *Lynchia hirsuta* (br).
Lophortyx douglasii bensoni (Ridgway); elegant quail: *Stilbometopa impressa* (br).
Lophortyx gambelii gambelii Gambel; Gambel's quail: *Ornithoica vicina* (ae); *Stilbometopa impressa* (br); [*Lynchia hirsuta;* in captivity only]; *Microlynchia pusilla* (br).
Odontophorus capueira capueira (Spix); capoeira in Brazil: *Lynchia plaumanni* (?br).
Odontophorus guttatus veraguensis Gould: *Ornithoctona erythrocephala* (?br).
Odontophorus hyperethrus Gould: *Ornithoctona erythrocephala* (?br).
Odontophorus strophium (Gould): *Ornithoctona erythrocephala* (?br).
Oreortyx picta picta (Douglas) [*O. p. plumifera* Gould]; plumed quail: *Stilbometopa impressa* (?br); *Lynchia hirsuta* (?br).
Pedioecetes phasianellus campestris Ridgway; prairie sharp-tailed grouse; gélinote à queue fine: *Lynchia americana* (?ae).
**Phasianus colchicus* Linnaeus; ring-necked pheasant (a mixture of two or more subspecies in North America): *Ornithomyia fringillina* (ae); *Ornithoctona erythrocephala* (ae); *Lynchia americana* (ae).

Meleagridae (Turkeys)

Agriocharis ocellata (Cuvier); ocellated turkey; pavo-del-monte, pavo silvestre, or kutz (Maya) in Mexico: *Olfersia coriacea* (?br).
Meleagris gallopavo gallopavo Linnaeus; domestic turkey; perú in Brazil; guajalote in Mexico: *Stilbometopa podopostyla* (ae); *Olfersia coriacea* (ae).
Meleagris gallopavo silvestris Vieillot; eastern wild turkey: *Lynchia americana* (br).

9. Order Gruiformes

Eurypygidae (Sun Bitterns)

Eurypyga helias major Hartlaub: *Ornithoctona erythrocephala* (?ae).

Rallidae (Rails)

Aramides saracura (Spix); saracura: *Lynchia holoptera* (br).
Atlantisia rogersi Lowe; Tristan da Cunha flightless rail: *Ornithomyia parva* (br).
Coturnicops noveboracensis (Gmelin); yellow rail; râle jaune: *Lynchia holoptera* (br).
Gallinula chloropus cachinnans Bangs; Florida gallinule: *Lynchia albipennis* (ae).
Porphyriornis comeri Allen: *Ornithomyia parva* (br).
Porphyrula martinica (Linnaeus); cuatezcatl (Náhuatl) in Mexico: *Lynchia albipennis* (ae).
Porzana carolina (Linnaeus); sora; râle ortolan: *Lynchia albipennis* (ae).
Rallus limicola limicola Vieillot; Virginia rail: *Lynchia holoptera* (br).

10. Order Charadriiformes

Charadriidae (Plovers, Sandpipers); including Scolopacidae, Recurvirostridae and Phalaropodidae

Capella nobilis (Selater): *Lynchia angustifrons* (ae).
Philohela minor (Gmelin); American woodcock; bécasse: *Ornithomyia fringillina* (ae); *Lynchia americana* (?ae).

Tringa melanoleuca (Gmelin); greater yellow-legs; grand chevalier à pattes jaunes: *Lynchia albipennis* (ac).

Laridae (Gulls, Terns, Skuas); including Stercorariidae and Rhynchopidae

Anoüs stolidus stolidus (Linnaeus); noddy tern: *Olfersia aenescens* (br).
Larosterna inca (Lesson); Inca tern: *Olfersia fossulata* (?br).
Larus belcheri Vigors; Belcher's gull: *Olfersia fossulata* (?br).
Larus delawarensis Ord; ring-billed gull: *Ornithomyia fringillina* (ac).
Larus fuliginosus Gould; dusky or lava gull: *Lynchia albipennis* (ac).
Sterna sp.: *Lynchia americana* (ac).
Sterna anaethetus melanoptera Swainson; bridled tern: *Olfersia aenescens* (?ac).
Sterna fuscata crissalis (Lawrence); American sooty tern: *Olfersia aenescens* (?ac).

Alcidae (Auks)

Uria lomvia lomvia (Linnaeus); Brünnich's murre: *Lynchia americana* (ac).

11. Order Columbiformes

Columbidae (Pigeons)

Claravis godefrida Temminck [*Peristera geoffroyi* Temminck]; pomba-espelho or pararú in Brazil: *Ornithoctona erythrocephala* (br).
Columba albilinea albilinea Bonaparte: *Ornithoctona erythrocephala* (br).
Columba inornata inornata Vigors: *Ornithoctona erythrocephala* (br).
Columba leucocephala Linnaeus; white-crowned pigeon: *Ornithoctona erythrocephala* (br); *Stilbometopa fulvifrons* (br); *Microlynchia pusilla* (br).
**Columba livia livia* Gmelin; domestic pigeon: *Ornithoctona erythrocephala* (ac); *Stilbometopa podopostyla* (ac); *Microlynchia pusilla* (ac); *Pseudolynchia canariensis* (br; introduced).
Columba picazuro picazuro Temminck; pomba-trocal in Brazil: *Ornithoctona erythrocephala* (br).
Columba (*?rufina pallidicrissa* Chubb): *Stilbometopa ramphastonis* (?ac); *Microlynchia pusilla* (br).
Columba rufina sylvestris Vieillot; pomba-verdadeira in Brazil: *Stilbometopa podopostyla* (br); *Lynchia americana* (ac); *Microlynchia crypturelli* (?ac); *Ornithoctona erythrocephala* (br).
Columba speciosa Gmelin; scaly-necked dove: *Stilbometopa podopostyla* (br).
Columba squamosa Bonnaterre: *Ornithoctona erythrocephala* (br).
Columba subvinacea bogotensis (Berlepsch and Leverkühn): *Ornithoctona erythrocephala* (br).
Columbigallina cruziana (Prévost): *Microlynchia pusilla* (br).
Columbigallina passerina nigrirostris Danforth: *Microlynchia pusilla* (br).
Columbigallina passerina portoricensis (Lowe): *Ornithoctona erythrocephala* (br).
Columbigallina talpacoti talpacoti (Temminck and Knip): *Microlynchia pusilla* (br); [*?*Pseudolynchia canariensis* (ac)].
Geotrygon versicolor (Lafresnaye) [*Geotrygon sylvatica* Gosse]: *Ornithoctona erythrocephala* (br); *Stilbometopa fulvifrons* (br).
Leptotila jamaicensis jamaicensis (Linnaeus): *Ornithoctona erythrocephala* (br).
Leptotila plumbeiceps plumbeiceps (Sclater and Salvin): *Ornithoctona fusciventris* (ac).
Leptotila rufaxilla reichenbachii Pelzeln; jurutí in Brazil: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (?ac); *Microlynchia pusilla* (br).
Leptotila verreauxi verreauxi (Bonaparte); torcaza in Spanish America: *Ornithoctona erythrocephala* (br); *Stilbometopa podopostyla* (br).

Leptotila verreauxi chalcauchenia (Sclater and Salvin): *Stilbometopa podopostyla* (br).
Leptotila verreauxi decipiens (Salvadori) [*L. v. ochroptera* Pelzeln]: *Stilbometopa podopostyla* (br).
Leptotila verreauxi fulviventris (Lawrence); tsutsuy (Maya) in Mexico: *Stilbometopa podopostyla* (br).
Metropelia ceciliae ceciliae (Lesson): *Microlynchia pusilla* (br).
Nesopelia galapagoensis (Gould): *Microlynchia galapagoensis* (?br).
Oreopeleia [now *Geotrygon*] *bourcieri frenata* (Tschudi): *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *caniceps leucometopius* Chapman: *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *chrysia* (Bonaparte): *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *linearis infusca* (Bangs): *Ornithoica vicina* (ae); *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *montana montana* (Linnaeus); ruddy quail dove: *Ornithoctona erythrocephala* (br); *Ornithoctona* (*Ornithopertha*) *nitens* (?br); *Stilbometopa fulvifrons* (br).
Oreopeleia [now *Geotrygon*] *mystacea beattyi* Danforth: *Microlynchia pusilla* (br).
Oreopeleia [now *Geotrygon*] *mystacea sabae* (Riley): *Ornithoctona erythrocephala* (br).
Oreopeleia [now *Geotrygon*] *violacea albiventer* (Lawrence): *Ornithoctona erythrocephala* (br).
Scardafella inca (Lesson); Inca dove; cocotli (Náhuatl), lucu (Mixteco), or joño (Otomí) in Mexico: *Microlynchia pusilla* (br).
Scardafella squammata squammata (Lesson) [*Columba squamosa* Temminck, not of Bonaterre]; rolinha-cascaval or fogo-apagou in Brazil: *Stilbometopa podopostyla* (br); *Microlynchia pusilla* (br).
**Streptopelia chinensis chinensis* (Scopoli); Chinese spotted dove: *Microlynchia pusilla* (ae).
Zenaida asiatica asiatica (Linnaeus) [*Melopelia leucoptera* Linnaeus]; white-winged dove; sakpakal (Maya) in Mexico: *Ornithoctona erythrocephala* (br); *Stilbometopa podopostyla* (br); *Microlynchia pusilla* (br).
Zenaida asiatica mearnsi (Ridgway): *Microlynchia pusilla* (br).
Zenaida asiatica meloda (Tschudi): *Ornithoctona erythrocephala* (br).
Zenaida aurita aurita (Temminck): *Ornithoctona erythrocephala* (br).
Zenaida aurita zenaida (Bonaparte) [*Zenaida amabilis* Bonaparte]; zenaida dove: *Ornithoctona erythrocephala* (br).
Zenaidura auriculata hypoleuca (Bonaparte): *Ornithoctona erythrocephala* (br).
Zenaidura auriculata rubripes (Lawrence): *Microlynchia pusilla* (br).
Zenaidura macroura macroura (Linnaeus); West Indian mourning dove: *Ornithoctona erythrocephala* (br).
Zenaidura macroura carolinensis (Linnaeus); eastern mourning dove; tourterelle triste: *Stilbometopa podopostyla* (br); *Lynchia americana* (ae); *Microlynchia pusilla* (br).
Zenaidura macroura clarionensis C. H. Townsend: *Microlynchia pusilla* (br).
Zenaidura macroura marginella (Woodhouse); western mourning dove; huilota or uilotl (Náhuatl) in Mexico: *Stilbometopa podopostyla* (br); *Microlynchia pusilla* (br).

12. **Order Psittaciformes**

Psittacidae (Parrots)

Amazona aestiva xanthopteryx (Berlepsch): *Ornithoctona erythrocephala* (br); *Lynchia angustifrons* (ae).

Amazona collaris (Linnaeus); yellow-billed parrot: *Ornithoica vicina* (ac).
Amazona guildingii (Vigors): *Ornithoctona erythrocephala* (br).
Amazona leucocephala leucocephala (Linnaeus): *Ornithoica vicina* (ac); *Ornithoctona erythrocephala* (br).
Amazona ventralis (P.L.S. Müller): *Ornithoctona erythrocephala* (br).
Amazona vinacea (Kuhl); jurueba in Brazil: *Ornithoctona erythrocephala* (br).
Aratinga nana (Vigors): *Ornithoctona erythrocephala* (br).
Pionus sordidus saturatus Todd: *Ornithoctona erythrocephala* (br).
Pionus tumultuosus (Tschudi): *Ornithoctona erythrocephala* (br).

13. **Order Cuculiformes**

Cuculidae (Cuckoos)

Geococcyx californianus (Lesson); roadrunner; chaparral cock: *Microlynchia pusilla* (br).
Piaya cayana macroura Gambel; alma-de-caboclo or tinguaçú in Brazil: *Ornithoica vicina* (ac); *Lynchia latifacies* (?br).
Piaya cayana mehleri Bonaparte [*P. c. columbiana* Cabanis]: *Ornithoctona erythrocephala* (ac).
Piaya cayana nigricrissa (Cabanis): *Lynchia latifacies* (?br).
Piaya cayana pallescens (Cabanis and Heyne): *Lynchia nigra* (ac).
Saurothera vetula vetula (Linnaeus): *Ornithoctona erythrocephala* (ac); *Stilbometopa fulvifrons* (ac).
Saurothera vetula vieilloti Bonaparte: *Ornithoctona erythrocephala* (ac).

14. **Order Strigiformes**

Strigidae (Owls); including Tytonidae

Aegolius [formerly *Cryptoglaux*] *acadicus acadicus* (Gmelin); saw-whet owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Asio flammeus flammeus (Pontoppidan); short-eared owl; hibou à oreilles courtes: *Ornithoica vicina* (br).
Asio flammeus portoricensis Ridgway: *Ornithoctona erythrocephala* (?ac).
Asio flammeus suinda (Vieillot) [*A. f. breviauris* Schlegel]: *Ornithoctona erythrocephala* (?ac); *Lynchia wolcotti* (?ac).
Asio stygius siguapa (d'Orbigny): *Ornithoctona erythrocephala* (?ac).
Asio wilsonianus (Lesson); long-eared owl; hibou à oreilles longues: *Ornithoica vicina* (br); *Ornithomyia fringillina* (ac); *Lynchia americana* (br).
Bubo virginianus virginianus (Gmelin); great horned owl or long-eared owl; duc de Virginie or grand-duc: *Ornithoica vicina* (br); *Ornithomyia fringillina* (ac); *Lynchia americana* (br).
Bubo virginianus mayensis Nelson: *Lynchia americana* (br).
Bubo virginianus pacificus Cassin; Pacific horned owl: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lipoptena depressa* (ac); *Neolipoptena ferrisi* (ac).
Bubo virginianus pallescens Stone; western horned owl: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia nigra* (ac).
Bubo virginianus saturatus Ridgway; dusky horned owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Bubo virginianus wapacuthu (Gmelin) [*B. v. subarcticus* Hoy]; arctic horned owl: *Lynchia americana* (br).
Ciccaba virgata virgata (Cassin): *Ornithoica vicina* (br).
Ciccaba virgata borelliana (Bertoni): *Ornithoica vicina* (br); *Lynchia americana* (br).
Ciccaba virgata centralis Griscom: *Lynchia wolcotti* (?ac); *Lynchia angustifrons* (ac).
Glaucidium brasilianum brasilianum (Gmelin); caninde in Brazil: *Lynchia americana* (br); *Lynchia angustifrons* (ac).

Glaucidium brasilianum phaloenoides (Daudin): *Lynchia wolcotti* (?ae).
Glaucidium brasilianum ridgwayi Sharpe: *Ornithoica vicina* (br); *Lynchia angustifrons* (ae).
Glaucidium gnoma californicum Selater; California pygmy owl: *Ornithomyia fringillina* (ae).
Glaucidium nanum (King); chuncho in Chile: *Ornithomyia parva* (ae).
Glaucidium siju (d'Orbigny): *Ornithoctona erythrocephala* (?ae).
[*?Lophostrix cristata stricklandi* Selater and Salvin): *Lynchia wolcotti* (?ae)].
Otus albogularis albogularis (Cassin): *Ornithoica vicina* (br).
Otus asio asio (Linnaeus); southern screech owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio bendirei (Brewster); California screech owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio brewsteri Ridgway; Brewster's screech owl: *Lynchia americana* (br).
Otus asio floridanus (Ridgway); Florida screech owl: *Lynchia americana* (br).
Otus asio kennicottii (Elliot) [*O. a. saturatus*]; Kennicott's screech owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio mccallii (Cassin); Texas screech owl: *Ornithomyia fringillina* (ae); *Lynchia americana* (br).
Otus asio macfarlanei (Brewster); MacFarlane's screech owl: *Lynchia americana* (br).
Otus asio naevius (Gmelin); eastern screech owl; hibou maculé or petit-duc: *Ornithoica vicina* (br); *Lynchia americana* (br).
Otus asio quercinus Grinnell; Pasadena screech owl: *Lynchia americana* (br).
Otus choliba choliba (Vieillot): *Lynchia americana* (br).
Otus guatemalae guatemalae (Sharpe): *Ornithoica vicina* (br); *Lynchia wolcotti* (br).
Otus nudipes nudipes (Daudin): *Ornithoctona erythrocephala* (?ae).
Pseudoscops grammicus (Gosse); Jamaican owl: *Ornithoica vicina* (br); *Ornithoctona erythrocephala* (?ae).
Pulsatrix perspicillata pulsatrix (Wied): *Lynchia americana* (br).
Rhinoptynx clamator clamator (Vieillot); mocho-orelhudo in Brazil: *Lynchia americana* (br); *Lynchia albipennis* (ae); *Lynchia wolcotti* (br).
Speotyto cunicularia grallaria (Temminck); caboré-do-campo or coruja-buraqueira in Brazil: *Lynchia americana* (br).
Speotyto cunicularia hypugaea (Bonaparte); western burrowing owl; zacatecólotl in Mexico: *Lynchia americana* (br).
Strix hylophila Temminck: *Ornithoica vicina* (br); *Lynchia americana* (br).
Strix nebulosa nebulosa J.R. Forster; great gray owl; chouette cendrée: *Ornithoctona erythrocephala* (?ae); *Lynchia americana* (br).
Strix occidentalis occidentalis (Xantus); California spotted owl: *Ornithoica vicina* (br).
Strix occidentalis caurina (Merriam); northern spotted owl: *Lynchia americana* (br.)
Strix occidentalis lucida (Nelson); Mexican spotted owl: *Ornithoica vicina* (br); *Lynchia americana* (br).
Strix rufipes rufipes King; concón in Chile: *Ornithoica vicina* (br).
Strix varia varia Barton; northern barred owl; chat-huant: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia angustifrons* (ae).
Strix varia georgica Latham [*S. v. alleni* Ridgway]; Florida barred owl: *Lynchia americana* (br); *Olfersia sordida* (ae).
Surnia ulula caparoch (P.L.S. Müller); American hawk owl; chouette épervière: *Ornithomyia fringillina* (ae).
Tyto alba contempta (Hartert): *Ornithoctona erythrocephala* (?ae); *Olfersia fossulata* (ae).
Tyto alba furcata Temminck: *Ornithoica vicina* (br); *Ornithoctona erythrocephala* (?ae).

Tyto alba pratincola (Bonaparte); barn owl; lechuza or yohoaltecolotl in Mexico: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia albipennis* (ac).

Tyto alba tuidara J. E. Gray; suindara in Brazil: *Ornithoica vicina* (br); *Lynchia americana* (br); *Lynchia wolcotti* (br).

15. **Order Caprimulgiformes**

Caprimulgidae (Goatsuckers)

Caprimulgus carolinensis Gmelin; chuck-will's widow: *Pseudolynchia brunnea* (br); *Microlynchia pusilla* (ac).

Caprimulgus vociferus vociferus (Wilson); whip-poor-will; puevy or ehecachichinqui (Náhuatl) in Mexico: *Pseudolynchia brunnea* (br).

Chordeiles acutipennis acutipennis (Hermann): *Pseudolynchia brunnea* (br).

Chordeiles minor minor (Forster); eastern nighthawk; mange-maringouins: *Pseudolynchia brunnea* (br).

Chordeiles minor chapmani Coues; Florida nighthawk: *Pseudolynchia brunnea* (br).

Chordeiles minor gundlachii Lawrence: *Ornithoctona erythrocephala* (ac).

Hydropsalis brasiliana brasiliana (Gmelin) [*H. torquata* Gmelin]: *Pseudolynchia brunnea* (br).

Nyctidromus albicollis derbyanus Gould; curiango in Brazil: *Pseudolynchia brunnea* (br).

Phalaenoptilus nuttallii nuttallii (Audubon); Nuttall's poor-will; paxacua in Mexico: *Pseudolynchia brunnea* (br).

Setopagis parvula parvula (Shaw and Nodder); dormilon in Argentina: *Pseudolynchia brunnea* (br).

Siphonorhis americanus americanus (Linnaeus): *Ornithoctona erythrocephala* (ac; in Jamaica, where the bird is now extinct).

16. **Order Apodiformes**

Apodidae (Swifts)

Aëronautes montivagus montivagus (d'Orbigny and Lafresnaye): *Myiophthiria* (*Brachypteromyia*) *neotropica* (br).

Aëronautes saxatilis saxatilis (Woodhouse); white-throated swift: *Myiophthiria* (*Brachypteromyia*) *fimbriata* (br).

Nephoecetes [now *Cypseloides*] *niger borealis* (Kennerly); black swift: *Myiophthiria* (*Brachypteromyia*) *fimbriata* (br).

Trochilidae (Hummingbirds)

Phaethornis superciliosus longirostris (De Lattre): *Ornithoctona* (*Ornithopertha*) *nitens* (?ac).

17. **Order Trogoniformes**

Trogonidae (Trogons)

Pharomachrus mocino mocino de la Llave: *Ornithoctona erythrocephala* (ac); *Ornithoctona* (*Ornithopertha*) *nitens* (br).

Pharomachrus mocino costaricensis Cabanis: *Ornithoctona fusciventris* (ac); *Ornithoctona* (*Ornithopertha*) *nitens* (br).

Temnotrogon roseigaster (Vieillot): *Ornithoctona erythrocephala* (ac).

Trogon sp.?: *Ornithoctona* (*Ornithopertha*) *nitens* (br); *Lynchia angustifrons* (ac).

Trogon collaris puella Gould: *Ornithoctona* (*Ornithopertha*) *nitens* (br).

Trogon massena massena Gould: *Ornithoctona* (*Ornithopertha*) *nitens* (br).

Trogon personatus personatus Gould: *Ornithoctona* (*Ornithopertha*) *nitens* (br).

Trogon surrucura aurantius Spix; surucua in Brazil: *Stilbometopa ramphastonis* (ac).

18. Order Coraciiformes

Alcedinidae (Kingfishers)

Megaceryle alcyon alcyon (Linnaeus); eastern belted kingfisher; martin-pêcheur: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (ac).

Momotidae (Motmots)

Baryphthengus ruficapillus ruficapillus (Vieillot) [*Momotus "rufescens"* of some authors]; juruva, formigão, or pururú in Brazil: *Lynchia angustifrons* (ac).
Momotus momota momota (Linnaeus): *Ornithoctona fusciventris* (ac).
Momotus momota aequatorialis Gould: *Ornithoctona erythrocephala* (ac).
Momotus momota chlorolaemus Berlepsch and Stolzmann: *Ornithoctona erythrocephala* (ac).
Momotus momota coeruliceps (Gould): *Lynchia angustifrons* (ac).
Momotus momota lessonii Lesson: *Ornithoctona fusciventris* (ac).
Momotus momota subrufescens Selater: *Ornithoctona fusciventris* (ac).

19. Order Piciformes

Picidae (Woodpeckers)

Colaptes auratus luteus Bangs; northern flicker; pivert doré: *Ornithomyia fringillina* (ac).
Colaptes cafer cafer (Gmelin); northwestern flicker: *Ornithomyia fringillina* (ac).
Colaptes cafer collaris Vigors; red-shafted flicker: *Ornithomyia fringillina* (ac).
Colaptes campestris campestroides (Malherbe) [*Geopicos agricola* Malherbe]; pícapau in Brazil: *Ornithoica vicina* (ac).
Colaptes pitius pitius (Molina): *Ornithomyia parva* (=*remota*) (ac).
Dendrocopos [formerly *Dryobates*] *pubescens pubescens* (Linnaeus); southern downy woodpecker: *Ornithoica vicina* (ac).
Dendrocopos pubescens gairdnerii (Audubon); Gairdner's downy woodpecker: *Ornithomyia fringillina* (ac).
Dendrocopos pubescens leucurus (Hartlaub); Batchelder's woodpecker: *Ornithomyia fringillina* (ac).
Dendrocopos pubescens medianus (Swainson); northern downy woodpecker; pic minule: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (ac).
Dendrocopos villosus villosus (Linnaeus); eastern hairy woodpecker; pic chevelu: *Ornithomyia fringillina* (ac).
Dendrocopos villosus extimus (Bangs): *Ornithoctona fusciventris* (ac).
Dendrocopos villosus harrisi (Audubon); Harris' woodpecker: *Ornithomyia fringillina* (ac).
Dryocopus [formerly *Ceophloeus* or *Hylatomus*] *pileatus abieticola* (Bangs); northern pileated woodpecker: *Lynchia americana* (ac).
Melanerpes herminieri Lesson [*Linneopicus therminieri* of some authors]: *Ornithoctona erythrocephala* (ac).
Melanerpes superciliaris superciliaris (Temminck): *Ornithoctona erythrocephala* (ac).
Picoides arcticus (Swainson); arctic three-toed woodpecker; pic à dos noir: *Ornithomyia fringillina* (ac).
Sphyrapicus varius varius (Linnaeus); yellow-bellied sapsucker; pic à ventre jaune: *Ornithomyia fringillina* (ac); *Ornithoctona erythrocephala* (ac).

Sphyrapicus varius nuchalis Baird; red-naped sapsucker: *Ornithomyia fringillina* (ac).
Sphyrapicus varius ruber (Gmelin); northern red-breasted sapsucker: *Ornithomyia fringillina* (ac).
Veniliornis affinis ruficeps (Spix): *Lynchia angustifrons* (ac).

Ramphastidae (Toucans)

Pteroglossus aracari aracari (Linnaeus) [*P. a. wiedi* Sturm]; araçarí in Brazil: *Lynchia angustifrons* (ac).
Ramphastos dicolorus Linnaeus; tucano-de-bico-verde in Brazil: *Ornithoica vicina* (ac); *Ornithoctona erythrocephala* (ac); *Lynchia angustifrons* (ac).
Ramphastos sulfuratus sulfuratus Lesson: *Ornithoica vicina* (ac); *Lynchia angustifrons* (ac).
Ramphastos sulfuratus brevicarinatus Gould: *Lynchia angustifrons* (ac).
Ramphastos swainsonii Gould: *Ornithoica vicina* (ac); *Stilbometopa ramphastonis* (?br); *Lynchia angustifrons* (ac).
Ramphastos toco toco P.L.S. Müller; tucanuçú in Brazil: *Ornithoica vicina* (ac).
Ramphastos vitellinus ariel Vigors; tucano-de-bico-preto in Brazil: *Ornithoica vicina* (ac).

20. **Order Passeriformes**

Rhinocryptidae (Tapaculos)

Scytalopus femoralis sanctae-martae Chapman: *Ornithoctona fusciventris* (?br).

Formicariidae (Antbirds)

Cercomacra tyrannina rufiventris (Lawrence): *Ornithoctona fusciventris* (br).
Chamaeza campanisona campanisona (Lichtenstein) [*Turdus brevicaudus* Vieillot]: *Stilbometopa podopostyla* (ac); *Lynchia plaumanni* (?br).
Drymophila ferruginea (Temminck): *Ornithoica vicina* (?br).
Grallaria rufula rufula Lafresnaye: *Ornithoctona fusciventris* (br).
Thamnophilus caerulescens caerulescens Vieillot; choca in Brazil: *Ornithoctona fusciventris* (br).
Thamnophilus caerulescens gilvigaster Pelzeln: *Ornithoctona fusciventris* (br).
Thamnophilus melanchrous Sclater and Salvin: *Ornithoctona fusciventris* (br).
Thamnophilus unicolor grandior Hellmayr: *Lynchia holoptera* (?br).

Furnariidae (Ovenbirds, Woodhewers); including Dendrocolaptidae

Anabacerthia striaticollis striaticollis Lafresnaye: *Ornithoctona fusciventris* (br).
Asthenes patagonica (d'Orbigny): type host of *Ornithomyia synallaxidis* Lynch-Arribalzaga, 1881 (? = *Ornithomyia parva* Macquart, 1843).
Cinclodes nigro-fumosus (d'Orbigny and Lafresnaye): *Ornithomyia parva* (br).
Lepidocolaptes affinis lachrymiger (Des Murs): *Ornithoctona fusciventris* (br).
Margarornis squamiger squamiger (d'Orbigny and Lafresnaye): *Ornithoctona erythrocephala* (ac).
Sclerurus scansor scansor (Ménétriés); vira-fôhls or pinchacisco in Brazil: *Ornithoctona fusciventris* (br).
Synallaxis unirufa unirufa Lafresnaye: *Ornithoctona fusciventris* (br).
Syndactyla rufosuperciliata rufosuperciliata (Lafresnaye): *Ornithoica vicina* (br).
Thripadectes flammulatus flammulatus (Eyton): *Ornithoica vicina* (br).
Xenops rutilans rutilans Temminck: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (ac).

Tyrannidae (Tyrant Flycatchers)

Agriornis livida livida (Kittlitz); diucon in Chile: *Ornithomyia parva* (br).
Cnemotriccus poecilurus poecilurus (Sclater): *Ornithoctona oxycera* (?br).
Colonia colonus colonus (Vieillot): *Ornithoctona fusciventris* (br).
Empidonax flavescens Lawrence: *Ornithoctona fusciventris* (br).
Empidonax flaviventris (Baird): *Ornithoctona fusciventris* (br).
Empidonax virescens (Vieillot); American flycatcher: *Ornithoctona fusciventris* (br).
Muscisaxicola fluviatilis Sclater and Salvin: *Ornithoctona fusciventris* (br).
Muscisaxicola macloviana mentalis d'Orbigny and Lafresnaye: *Ornithomyia parva* (br).
Muscivora tyrannus (Linnaeus); fork-tailed flycatcher: *Stilbometopa ramphastonis* (?ae).
Myiobius barbatus atricaudus (Lawrence): *Ornithoctona erythrocephala* (?ae).
Myiochanes fumigatus ardosiacus (Lafresnaye): *Ornithoctona fusciventris* (br).
Myiodynastes chrysocephalus chrysocephalus (Tschudi): *Ornithoctona oxycera* (?br).
Myiodynastes hemichrysus (Cabanis): *Ornithoica vicina* (br).
Myiotheretes striaticollis striaticollis (Sclater): *Ornithoctona fusciventris* (br).
Pitangus sulphuratus maximiliani (Cabanis and Heyne); bemtevi-commum in Brazil: *Ornithoica vicina* (br).
Pyrocephalus rubinus obscurus Gould: *Ornithoica vicina* (br).
Sayornis saya saya (Bonaparte); Say's phoebe: *Ornithomyia fringillina* (?br).
Tyrannus melancholicus melancholicus Vieillot: *Ornithoica vicina* (br).
Tyrannus tyrannus (Linnaeus); eastern kingbird; tritri: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).

Pipridae (Manakins)

Pipra chloromeros (Tschudi): *Ornithoctona erythrocephala* (ae).

Cotingidae (Cotingas)

Cephalopterus ornatus ornatus Geoffroy de St. Hilaire: *Ornithoica vicina* (br).
Lipaugus holerythrus holerythrus Sclater and Salvin: *Ornithoctona fusciventris* (ae).
Platypsaris niger (Gmelin) [*Tityra leuconotus* of authors]: *Ornithoctona erythrocephala* (ae); *Stilbometopa fulvifrons* (ae).
Pyroderus scutatus scutatus (Shaw); pavó in Brazil: *Ornithoica vicina* (br); *Lynchia angustifrons* (ae).

Hirundinidae (Swallows)

Alopochelidon fuscata (Temminck): *Crataerina seguyi* (br).
Iridoprocne albiventer (Boddaert): *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Notiochelidon [or *Pygochelidon*] *cyanoleuca cyanoleuca* (Vieillot); andorinha-pequena in Brazil: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Notiochelidon cyanoleuca patagonica (d'Orbigny and Lafresnaye): *Crataerina seguyi* (br).
Notiochelidon murina (Cassin): *Crataerina seguyi* (br).
Progne chalybea domestica (Vieillot); andorinha-grande in Brazil: *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Stelgidopteryx ruficollis ruficollis (Vieillot): *Ornithomyia* (*Pseudornithomyia*) *ambigua* (br).
Tachycineta thalassina lepida Mearns; violet-green swallow: *Myiophthiria* (*Brachypteromyia*) *fimbriata* (br).

Muscicapidae (Flycatchers, Warblers, Thrushes, etc.); including Sylviidae,

Turdidae, Compsothlypidae or Parulidae, Mimidae, Troglodytidae, Chamaeidae, and Cinclidae.

Catharus occidentalis occidentalis (Sclater): *Ornithomyia fringillina* (?ac).
Chamaea fasciata phaea Osgood; coast wren-tit: *Ornithoica vicina* (?br).
Cinclus mexicanus unicolor Bonaparte; dipper: *Ornithoica vicina* (br).
Cinnycerthia unirufa unirufa (Lafresnaye): *Ornithoctona fusciventris* (br).
Compsothlypis [now *Parula*] *americana pusilla* (Wilson); northern parula warbler; fauvette parula: *Ornithomyia fringillina* (?br).
Corthylio [now in *Regulus*] *calendula calendula* (Linnaeus); eastern ruby-crowned kinglet; roitelet à couronne rubis: *Ornithoica vicina* (br).
Corthylio [now in *Regulus*] *calendula cineraceus* (Grinnell); western ruby-crowned kinglet: *Ornithoica vicina* (br).
Dendroica aestiva aestiva (Gmelin) [*Dendroica petechia aestiva*]; eastern yellow warbler; fauvette jaune: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Dendroica castanea (Wilson); bay-breasted warbler; fauvette à poitrine baie: *Ornithomyia fringillina* (br).
Dendroica coronata coronata (Linnaeus); myrtle warbler; fauvette à croupion jaune: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Dendroica graciae decora Ridgway: *Ornithoctona fusciventris* (br).
Dendroica pinus pinus (Wilson); northern pine warbler: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Dendroica pinus chrysoleuca Griscom: *Ornithoctona fusciventris* (br).
Dendroica striata (J.R. Forster); black-poll warbler; fauvette rayée: *Ornithoctona oxycera* (?ac).
Dendroica tigrina (Gmelin); Cape May warbler: *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).
Dumetella carolinensis (Linnaeus); catbird; merle-chat: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Geothlypis trichas trichas (Linnaeus); Maryland yellow-throat; fauvette masquée: *Ornithomyia fringillina* (br).
Geothlypis trichas brachidactyla (Swainson); northern yellow-throat: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Helmitheros vermivorus (Gmelin); worm-eating warbler: *Ornithomyia fringillina* (br).
Henicorhina leucophrys collina (Bangs): *Ornithoctona fusciventris* (br).
Hylocichla fuscescens fuscescens (Stephens); veery; grive de Wilson: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Hylocichla fuscescens salicicola Ridgway; willow thrush: *Pseudolynchia brunnea* (ac).
Hylocichla guttata guttata (Pallas); Alaska hermit thrush: *Ornithomyia fringillina* (br).
Hylocichla guttata faxoni Bangs and Penard; eastern hermit thrush: grive solitaire: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Hylocichla mustelina (Gmelin); wood thrush: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Stilbometopa fulvifrons* (ac); *Lynchia angustifrons* (ac).
Hylocichla ustulata ustulata (Nuttall); russet-backed thrush; grive à dos olive: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Hylocichla ustulata swainsoni (Tschudi); olive-backed thrush: *Ornithomyia fringillina* (br).
Icteria virens longicauda Lawrence [*Icteria virens auricollis* (Lichtenstein)]; long-tailed chat: *Ornithomyia fringillina* (br).
Mimus polyglottos polyglottos (Linnaeus); eastern mockingbird: *Microlynchia pusilla* (?br).
Mimus polyglottos leucopterus (Vigors); western mockingbird: *Ornithoica vicina* (br); *Microlynchia pusilla* (?br).
Mimus thenca (Molina); thenca in Chile: *Ornithomyia parva* (br).

Mniotilta varia (Linnaeus); black-and-white warbler; fauvette noire-et-blanche: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br); *Ornithoctona fusciventris* (br).

Myadestes townsendi townsendi (Audubon); Townsend's solitaire: *Ornithomyia fringillina* (?br).

Nesocichla eremita Gould [including *N. eremita gordoni* Starchies]; Tristan da Cunha hermit thrush: *Ornithomyia parva* (br).

Oporornis formosus (Wilson); Kentucky warbler: *Ornithomyia fringillina* (br).

Platycichla flavipes leucops (Taczanowski): *Ornithoctona fusciventris* (br).

Regulus satrapa satrapa Lichtenstein; eastern golden-crowned kinglet; roitelet à couronne dorée: *Ornithoica vicina* (br).

Regulus satrapa olivaceus Baird; western golden-crowned kinglet: *Ornithoica vicina* (br).

Seiurus aurocapillus aurocapillus (Linnaeus); oven-bird; fauvette à fourneau: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).

Seiurus noveboracensis noveboracensis (Gmelin); northern water-thrush; fauvette des ruisseaux du nord: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Setophaga ruticilla ruticilla (Linnaeus); American redstart; fauvette flamboyante: *Ornithomyia fringillina* (?br); *Ornithoctona fusciventris* (br).

Sialia sialis sialis (Linnaeus); eastern bluebird; oiseau-bleu: *Ornithomyia fringillina* (br).

Thryomanes bewickii spilurus (Vigors); Vigors' wren: *Ornithomyia fringillina* (?br).

Thryothorus ludovicianus ludovicianus (Latham); Carolina wren: *Ornithomyia fringillina* (?br).

Toxostoma curvirostre curvirostre (Swainson) [*Toxostoma curvirostre celsum* Moore]; curve-billed thrasher: *Microlynchia pusilla* (?br).

Toxostoma dorsale dorsale Henry [*T. crissalis* Henry]; crissal thrasher: *Microlynchia pusilla* (?br).

Toxostoma redivivum redivivum (Gambel); California thrasher: *Lynchia hirsuta* (ae).

Toxostoma rufum rufum (Linnaeus); eastern brown thrasher; grive rousse: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Microlynchia pusilla* (?br).

Troglodytes aëdon aëdon Vieillot; eastern house wren; railleur or troglodyte domestique: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Troglodytes aëdon parkmanii Audubon; western house wren: *Ornithoica vicina* (br).

Troglodytes musculus musculus Naumann [*Troglodytes wiedi* Berlepsch]; cambaxirra in Brazil: *Ornithoica vicina* (br).

Troglodytes musculus inquietus (Baird): *Ornithoctona* (*Ornithopertha*) *nitens* (ae).

Turdus fuscater gigas Fraser: *Ornithoctona fusciventris* (br).

Turdus grayi casius (Bonaparte): *Ornithoica vicina* (br).

Turdus magellanicus King; zorzal in Chile: *Ornithoica vicina* (br); *Ornithomyia parva* (br).

Turdus migratorius migratorius Linnaeus; eastern or American robin; merle d'Amérique: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Turdus migratorius propinquus Ridgway; western robin: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Turdus olivater sanctae-martae (Todd): *Ornithoctona oxycera* (?br); *Ornithoctona* (*Ornithopertha*) *nitens* (?br).

Turdus plebeius Cabanis: *Ornithoctona fusciventris* (br).

Turdus tristis cnephosa (Bangs): *Ornithoctona fusciventris* (br).

Vermivora celata lutescens (Ridgway); lutescent warbler: *Ornithomyia fringillina* (br).
Vermivora peregrina (Wilson); Tennessee warbler: *Ornithomyia fringillina* (br).
Vermivora pinus (Linnaeus); blue-winged warbler: *Ornithomyia fringillina* (br).
Vermivora ruficapilla ruficapilla (Wilson); Nashville warbler; fauvette à joues grises: *Ornithomyia fringillina* (br).
Wilsonia canadensis (Linnaeus); Canada warbler; mésange du Canada: *Ornithoctona fusciventris* (br).
Wilsonia citrina (Boddaert); hooded warbler: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).

Motacillidae (Wagtails, Pipits)

Anthus spinoletta rubescens (Tunstall); American pipit: *Ornithomyia fringillina* (?ac).

Laniidae (Shrikes)

Lanius ludovicianus excubitorides Swainson; white-rumped shrike: *Ornithomyia fringillina* (?br).
Lanius ludovicianus migrans Palmer; loggerhead shrike: *Ornithoica vicina* (?br); *Ornithomyia fringillina* (?br).

Sittidae (Nuthatches)

Sitta carolinensis carolinensis Latham [*Sitta carolinensis cookei* Oberholser]; white-breasted nuthatch: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Sitta pygmaea pygmaea Vigors; pygmy nuthatch: *Lipoptena depressa* (ac).

Paridae (Titmice)

Baeolophus [now in *Parus*] *bicolor* (Linnaeus); tufted titmouse: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Baeolophus [now in *Parus*] *inornatus inornatus* (Gambel); plain titmouse: *Ornithomyia fringillina* (br).
Penthestes [now in *Parus*] *atricapillus atricapillus* (Linnaeus); black-capped chickadee; mésange à tête noire: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Penthestes [now in *Parus*] *hudsonicus hudsonicus* (J.R. Forster); Hudsonian chickadee; mésange à tête brune: *Ornithomyia fringillina* (br).
Penthestes [now in *Parus*] *rufescens barlowi* (Grinnell); Barlow's chickadee: *Ornithomyia fringillina* (br).

Vireonidae (Vireos)

Vireo philadelphicus (Cassin); Philadelphia vireo: *Ornithoctona fusciventris* (?br)

Thraupidae (Tanagers, Honeycreepers); including Coerebidae

Calospiza arthus aurulenta (Lafresnaye): *Ornithoctona fusciventris* (br).
Calospiza labradorides labradorides (Boissonneau): *Ornithoctona fusciventris* (br).
Conirostrum rufum Lafresnaye: *Ornithoctona fusciventris* (br).
Dubusia taeniata taeniata (Boissonneau): *Ornithoctona fusciventris* (br).
Piranga bidentata sanguinolenta (Lafresnaye): *Ornithoctona fusciventris* (br).
Piranga erythromelas Vieillot [*Piranga olivacea* (Gmelin)]; scarlet tanager; tanagra écarlate: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br); *Ornithoctona fusciventris* (br).

Piranga flava hepatica (Swainson); hepatic tanager: *Ornithoica vicina* (br); *Ornithoctona fusciventris* (br).
Piranga leucoptera leucoptera (Trudeau): *Ornithoctona fusciventris* (br).
Piranga ludoviciana (Wilson); western tanager: *Ornithomyia fringillina* (br).
Piranga rubra rubra (Linnaeus); summer tanager: *Ornithoctona fusciventris* (br); *Lynchia albipennis* (ac).
Poecilothraupis igniventris lunulata (Du Bus): *Ornithoctona fusciventris* (br).
Poecilothraupis lachrymosa lachrymosa (Du Bus): *Ornithoctona fusciventris* (br).
Ramphocelus bresilius dorsalis Sclater: *Ornithoica vicina* (br).
Tachyphonus rufus (Boddaert): *Ornithoctona fusciventris* (br).
Tachyphonus xanthopygius xanthopygius Sclater: *Ornithoctona fusciventris* (br).
Thlypopsis sordida chrysopis (Sclater and Salvin): *Ornithoctona fusciventris* (br).
Thraupis cyanocephala olivicyanea (Lafresnaye): *Ornithoctona oxycera* (?br).

Fringillidae (Finches)

Ammodramus savannarum australis Maynard [*Ammodramus savannarum pratensis* (Vieillot)]; eastern grasshopper sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Arremonops rufivirgatus (Lawrence): Texas sparrow: *Microlynchia pusilla* (?ac).
Arremonops striaticeps (Lafresnaye): *Microlynchia pusilla* (?ac).
Atlapetes gutturalis (Lafresnaye): *Ornithoctona fusciventris* (br).
Atlapetes schistaceus schistaceus (Boissonneau): *Ornithoctona fusciventris* (br).
Atlapetes schistaceus tamae Cory: *Ornithoctona fusciventris* (br).
Atlapetes torquatus nigrifrons (Chapman): *Ornithoctona fusciventris* (br).
Carpodacus mexicanus frontalis (Say); common house finch or California linnet: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Carpodacus purpureus purpureus (Gmelin); eastern purple finch; pinson pourpre commun: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Carpodacus purpureus californicus Baird; California purple finch: *Ornithomyia fringillina* (br).
Coryphospingus cucullatus fargoi Brodkorb: *Ornithoctona fusciventris* (br).
Diuca diuca diuca (Molina) [*Diuca grisea* Sclater]; diuca in Chile: *Ornithomyia parva* (br).
Embernagra platensis olivascens (d'Orbigny); *Ornithomyia parva* (br).
Euetheia olivacea pusilla (Swainson): *Ornithoctona fusciventris* (br).
Hedymeles [now *Pheucticus*] *ludovicianus* (Linnaeus); rose-breasted grosbeak; gros-bec à poitrine rose: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).
Hedymeles melanocephalus melanocephalus (Swainson) [now *Pheucticus melanocephalus maculatus* (Audubon)]; black-headed grosbeak: *Ornithomyia fringillina* (br); *Microlynchia pusilla* (?ac).
Hesperiphona vespertina vespertina (W. Cooper); eastern evening grosbeak: *Ornithomyia fringillina* (br).
Hesperiphona vespertina brooksi Grinnell; western evening grosbeak: *Ornithomyia fringillina* (br).
Junco hyemalis hyemalis (Linnaeus); slate-colored junco; junco ardoisé: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Junco hyemalis carolinensis Brewster; Carolina junco: *Ornithoica vicina* (br).
Junco mearnsi Ridgway [*Junco oreganus mearnsi*]; pink-sided junco: *Ornithomyia fringillina* (br).
Junco oreganus oreganus (Townsend); Oregon junco: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Junco oreganus shufeldti Coale; Shufeldt's junco: *Ornithomyia fringillina* (br).
Junco oreganus thurberi Anthony; Thurber's junco: *Ornithoica vicina* (br); *Lynchia hirsuta* (ae).
Junco phaeonotus dorsalis Henry [*Junco caniceps dorsalis*]; red-backed junco: *Ornithoica vicina* (br).
Junco phaeonotus fulvescens Nelson: *Ornithoctona fusciventris* (br).
Loxia curvirostra bendirei Ridgway; Bendire's crossbill: *Ornithomyia fringillina* (br).
Loxia curvirostra pusilla Gloger [*Loxia curvirostra minor* (Brehm)]; red crossbill; bec-croisé rouge: *Ornithomyia fringillina* (br).
Melospiza georgiana georgiana Latham; swamp sparrow; pinson des marais: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Melospiza lincolnii lincolnii (Audubon); Lincoln's sparrow; pinson de Lincoln: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Melospiza lincolnii gracilis (Kittlitz); Forbush's sparrow: *Ornithomyia fringillina* (br).
Melospiza melodia melodia (Wilson); eastern song sparrow; pinson chanteur: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Melospiza melodia cooperi Ridgway; San Diego song sparrow: *Ornithoica vicina* (br).
Melospiza melodia gouldii Baird; Marin song sparrow: *Ornithoica vicina* (br.)
Melospiza melodia morphna Oberholser; rusty song sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Nesospiza acunhae (Cabanis); Tristan da Cunha bunting: *Ornithomyia parva* (br).
Nesospiza jessiae Eagle Clark; Gough bunting: *Ornithomyia parva* (br).
Nesospiza wilkinsi Lowe; Nightingale Island bunting: *Ornithomyia parva* (br).
Passerculus sandwichensis savanna (Wilson); eastern savannah sparrow; pinson des savanes: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Passerella iliaca subsp.; California fox sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).
Passerina cyanea (Linnaeus); indigo bunting. *Ornithomyia fringillina* (?br).
Pipilo aberti aberti Baird; Abert's towhee: *Lynchia hirsuta* (ae); *Microlynchia pusilla* (ae).
Pipilo aberti dumeticolus van Rossem; western Abert's towhee: *Lynchia hirsuta* (ae); *Microlynchia pusilla* (ae).
Pipilo erythrophthalmus erythrophthalmus (Linnaeus); red-eyed towhee or chewink: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Pipilo erythrophthalmus alleni Coues; white-eyed towhee: *Ornithoica vicina* (br).
Pipilo erythrophthalmus canaster Howell; Alabama towhee: *Ornithoica vicina* (br).
Pipilo fuscus carolae McGregor; Sacramento brown Towhee: *Ornithoica vicina* (br); *Lynchia hirsuta* (ae).
Pipilo fuscus crissalis (Vigors); California towhee: *Ornithoica vicina* (br); *Lynchia hirsuta* (ae).
Pipilo fuscus mesoleucus Baird; cañon towhee: *Ornithoica vicina* (br); *Microlynchia pusilla* (ae).
Pipilo fuscus petulans Grinnell and Swarth [*Pipilo fuscus wrangeli* (Bonaparte)]; San Francisco brown towhee: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Pipilo fuscus senicula Anthony; Anthony's towhee: *Ornithoica vicina* (br).
Pipilo maculatus falcifer McGregor; San Francisco towhee: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Pipilo maculatus megalonyx Baird; San Diego towhee: *Ornithoica vicina* (br).
Pipilo maculatus montanus Swarth; spurred towhee: *Ornithoica vicina* (br).

Pitylus fuliginosus (Daudin); bico-pimenta in Brazil: *Lynchia angustifrons* (ae).
Plectrophenax nivalis nivalis (Linnaeus); eastern snow bunting; bruant des neiges or oiseau blanc: *Ornithomyia fringillina* (?br).
Pooecetes gramineus gramineus (Gmelin); eastern vesper sparrow; pinson à ailes baies: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Ornithoctona fusciventris* (br).
Poospiza torquata torquata (Lefresnaye and d'Orbigny): *Ornithoctona fusciventris* (br).
Pselliophorus tibialis (Lawrence): *Ornithoctona fusciventris* (br).
Richmondena cardinalis cardinalis (Linnaeus); eastern cardinal: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Microlynchia pusilla* (ae).
Spizella arborea arborea (Wilson); eastern tree sparrow; pinson hudsonien: *Ornithomyia fringillina* (br).
Spizella passerina passerina (Bechstein); eastern chipping sparrow; pinson familier: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Spizella pusilla pusilla (Wilson); eastern field sparrow; pinson des champs: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Zonotrichia albicollis (Gmelin); white-throated sparrow; pinson à gorge blanche: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Lynchia americana* (ae).
Zonotrichia capensis antillarum (Riley): *Ornithoctona fusciventris* (br).
Zonotrichia capensis costaricensis Allen: *Ornithoctona fusciventris* (br).
Zonotrichia capensis peruviensis (Lesson): *Ornithoctona fusciventris* (br).
Zonotrichia coronata (Pallas) [*Zonotrichia atricapilla* (Gmelin)]; golden-crowned sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Zonotrichia leucophrys gambelii (Nuttall); Gambel's sparrow: *Ornithomyia fringillina* (br).
Zonotrichia leucophrys nuttalli Ridgway; Nuttall's sparrow: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Zonotrichia leucophrys pugetensis Grinnell; Puget Sound sparrow: *Ornithomyia fringillina* (br).
Zonotrichia pileata Boddaert: *Ornithomyia parva* (=*remota*) (br).

Icteridae (Troupials, American Blackbirds)

Agelaius phoeniceus phoeniceus (Linnaeus); eastern red-wing; étourneau à épaulettes: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Agelaius thilius thilius (Molina); trile in Chile: *Ornithomyia parva* (br).
Dives dives warszewiczi (Cabanis): *Ornithoctona erythrocephala* (ae).
Dolichonyx oryzivorus (Linnaeus); reedbird or bobolink: *Ornithomyia fringillina* (br).
Euphagus carolinus (P.L.S. Müller); rusty blackbird; mainate rouillé: *Ornithomyia fringillina* (br).
Euphagus cyanocephalus (Wagler); Brewster's blackbird: *Ornithoica vicina* (br).
Holoquiscalis jamaicensis gundlachii (Cassin): *Ornithoctona erythrocephala* (ae); *Stilbometopa fulvifrons* (?ae).
Icterus galbula Linnaeus; Baltimore oriole; oriole de Baltimore: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Icterus mesomelas mesomelas (Wagler): *Ornithoctona fusciventris* (br).
Molothrus ater ater (Boddaert); eastern cowbird; vacher: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).
Molothrus ater artemisiae Grinnell; Nevada cowbird: *Ornithomyia fringillina* (br).
Molothrus ater obscurus (Gmelin); dwarf cowbird: *Ornithoica vicina* (br); *Microlynchia pusilla* (ae).

Quiscalus quiscula quiscula (Linnaeus) [*Quiscalus quiscula stonei* Chapman]; purple grackle; grand mainate: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Quiscalus quiscula aeneus Ridgway [*Quiscalus quiscula versicolor* Vieillot]; bronzed grackle: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Sturnella magna magna (Linnaeus); eastern meadow lark; étourneau des prés: *Microlynchia pusilla* (?ac).

Sturnella magna meridionalis Sclater: *Ornithoctona fusciventris* (?br).

Sturnella militaris (Linnaeus): *Ornithomyia parva* (?br).

Xanthornus decumanus maculosus (Chapman): *Ornithoctona erythrocephala* (ac).

Ploceidae (Weaverbirds)

**Passer domesticus domesticus* (Linnaeus); English sparrow, moineau domestique: *Ornithoica vicina* (ac); *Ornithomyia fringillina* (ac).

Sturnidae (Starlings)

**Acridotheres* [formerly *Aethiopsar*] *cristatellus cristatellus* (Linnaeus); Chinese or Japanese starling, or crested mynah: *Ornithomyia fringillina* (ac).

**Sturnus vulgaris vulgaris* Linnaeus; starling; étourneau: *Ornithomyia fringillina* (ac).

Corvidae (Crows, Jays)

Aphelocoma californica californica (Vigors) [*Aphelocoma coerulescens californica*]; California jay: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Aphelocoma californica woodhouseii (Baird) [*Aphelocoma coerulescens woodhouseii*]; Woodhouse's jay: *Ornithoica vicina* (br).

[*Calocitta formosa formosa* (Swainson): *Lynchia americana* (ac, in Zoological Park)].

Corvus brachyrhynchos brachyrhynchos Brehm [*C. americanus* Audubon]; eastern crow; corneille d'Amérique: *Ornithoica vicina* (br); *Lynchia americana* (ac).

Corvus brachyrhynchos hesperis Ridgway; western crow: *Ornithomyia fringillina* (?br).

Corvus jamaicensis (Brisson): *Ornithoctona erythrocephala* (?br).

Corvus ossifragus Wilson; fish crow: *Lynchia americana* (ac).

Cyanocitta cristata cristata (Linnaeus) [*Cyanocitta cristata bromia* Oberholser]; northern blue jay; geai bleu: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br).

Cyanocitta stelleri stelleri (Gmelin); Steller's jay: *Ornithoica vicina* (br).

Cyanocitta stelleri frontalis (Ridgway); blue-fronted jay: *Ornithoica vicina* (br); *Ornithomyia fringillina* (br); *Lynchia hirsuta* (ac).

Cyanocorax caeruleus (Vieillot); gralha-azul in Brazil: *Ornithoica vicina* (br); *Lynchia angustifrons* (ac).

Cyanocorax chrysops chrysops (Vieillot); gralha-do-mato in Brazil: *Ornithoica vicina* (br).

Cyanolyca pulchra mitrata Ridgway: *Ornithoctona erythrocephala* (?ac).

Perisoreus canadensis canadensis (Linnaeus); Canada jay: geai du Canada: *Ornithoica vicina* (br); *Ornithomyia fringillina* (?br).

Pica pica hudsonia (Savine); American magpie: *Ornithoica vicina* (?br).

Uroleuca cristatella (Temminck): *Ornithoica vicina* (br).

Xanthoura yncas cyanodorsalis (Dubois): *Ornithoctona fusciventris* (?br).

II. Mammals

The nomenclature and sequence of the orders, families and genera are those of G.L. Simpson (1945). In the absence of an

up-to-date catalogue of all New World mammals, the specific and subspecific names were obtained from a variety of sources. Only a selection of English and other vernacular names is included.

As in the list of birds, "(br)" marks a true breeding host, "(ac)" an accidental or stray host, and an asterisk a host introduced by Man.

1. Order Carnivora

Canidae (Dogs, Wolves, Foxes)

Canis latrans Say; coyote: *Melophagus ovinus* (ac; introduced).
Canis lupus subsp.; Alaskan wolf: *Melophagus ovinus* (ac; introduced).

Mustelidae (Weasels and Allies)

Tayra [or *Grison*, or *Galera*] *barbara* (Linnaeus); grison: *Lipoptena mazamae* (ac).

2. Order Artiodactyla

Tayassuidae (Pecaris)

Tayassu [or *Pecari*] *angulatus* Cope; pecari: *Lipoptena mazamae* (ac).

Cervidae (Deer and Brocket)

Cervus canadensis Erxleben; wapiti or American elk: *Lipoptena cervi* (?ac; introduced); *Lipoptena depressa* (?ac).
Mazama americana (Erxleben); brocket: *Lipoptena mazamae* (br).
Mazama simplicicornis simplicicornis (Illiger); virá, virote, guazú-birá, guazú-caatinga in Brazil; matacan in Venezuela; biracho, sachacabra, or guazuncho in Argentina: *Lipoptena mazamae* (br).
Mazama simplicicornis nemorivaga (Cuvier); guazú-pitha: *Lipoptena mazamae* (br).
Mazama tema tema Rafinesque: *Lipoptena mazamae* (br).
Mazama tema reperticia Goldman: *Lipoptena mazamae* (br).
Odocoileus hemionus hemionus (Rafinesque); mule deer: *Neolipoptena ferrisi* (br); *Lipoptena depressa* (br); *Melophagus ovinus* (ac; introduced).
Odocoileus hemionus columbianus (Richardson); coast deer or black-tailed deer: *Neolipoptena ferrisi* (br); *Lipoptena depressa* (br).
Odocoileus virginianus virginianus Boddaert; Virginia deer: *Lipoptena mazamae* (br).
Odocoileus virginianus borealis Miller; northeastern Virginia deer: *Lipoptena cervi* (br; introduced).
Odocoileus virginianus gymnotis (Wiegmann); Venezuelan white-tailed deer; venado: *Lipoptena mazamae* (br).
Odocoileus virginianus leucurus (Douglas); western white-tailed deer: *Neolipoptena ferrisi* (br); *Lipoptena depressa* (br).
Odocoileus virginianus mexicanus (Gmelin) [*O. v. toltecus* de Saussure; *O. v. acapulcensis* Caton]; Mexican white-tailed deer; venado: *Lipoptena mazamae* (br).
Odocoileus virginianus osceola (Bangs); Florida deer: *Lipoptena mazamae* (br).
Odocoileus virginianus rothschildi (Thomas); Panama white-tailed deer: *Lipoptena mazamae* (br).
Ozotoceros [or *Blastocerus*] *bezoarticus* (J.E. Gray); pampas deer; guazú-ti or veado-campeiro in Brazil: *Lipoptena guimarãesi* (br).

Antilocapridae

Antilocapra americana Ord; prong-horn antelope: *Neolipoptena ferrisi* (ac).

Bovidae (Cattle, Sheep, Goats)

**Ovis aries* Linnaeus; domestic sheep: *Melophagus ovinus* (br; introduced).
Ovis (?*canadensis* Shaw or *dalli* Allen); American mountain sheep: [?*Melophagus ovinus*, introduced; very doubtful record].

ACKNOWLEDGMENTS

I am indebted, either for specimens or for information, to the following persons, whose assistance is herewith gratefully acknowledged: Frère Adrien Robert; C.G. Aguayo; the late J.M. Aldrich; C.P. Alexander; the late A. Alfaro; M. Alvarez del Toro; P.J. Anduze; the late Hermano Apolinar-María; A.F. Archer; P.H. Arnaud, Jr.; J. Assmuth; D. Augustine; G.F. Augustson; the late E.E. Austen; W.J. Baerg; R.H. Baker; S.C. Ball; L.P. Barattini; the late T. Barbour; E.S. Barker; Miss Katherine Bartlett; L.M. Bartlett; R.H. Beamer; H.A. Beatty; D.E. Beck; C.M. Beckman; W. Beebe; J.N. Belkin; R.K. Benjamin; C.O. Berg; S.W. Bilsing; the late H. Bird; F.C. Bishopp; R.L. Blickle; R.M. Bohart; G. Bouvier; B.S. Bowdish; Miss Elizabeth M. Boyd; J.M. Brennan; the late C.S. Brimley; the late S.W. Bromley; A.E. Brower; the late C.T. Brues; S.C. Bruner; Mrs. Ana María de Buen de Biagi; D.S. Bullock; G.D. Butler, Jr.; E. McC. Callan; S.K. Carnie; R.G. Carpenter, 2nd; M.A. Carriker, Jr.; T.D. Carter; C.L. Cartwright; G. Chagnon; W.J. Chamberlin; Mrs. Ruth Trimble Chapin; J.P. Chapin; H.E. Childs, Jr.; C.D.H. Clarke; W. Clarke-MacIntyre; Miss Theresa Clay; G.R. Coatney; the late T.D.A. Cockerell; E.I. Coher; A.C. Cole; J.E. Collin; D.L. Collins; Miss Fannye A. Cook; K.W. Cooper; I. McT. Cowan; the late E.T. Crampton; the late C.H. Cresson, Jr.; C.H. Curran; H.T. Dalmat; D.M. Davies; the late W.T. Davis; H. Dietrich; L.S. Dillon; R.P. Dow; R. R. Driesbach; L.H. Dunn; H. Dybas; R.B. Eads; L.R. Edmunds; the late H. Eidmann; F.I. van Emden; the late E.O. Engel; the late G.B. Engelhardt; H.E. Evans; the late H.E. Ewing; G.B. Fairchild; D.S. Farner; the late P.W. Fattig; G.F. Ferris; H. Floch; C.D. Fowle; I. Fox; R.M. Fox; R.S. Freeman; R. Frey; H. Friedmann; the late T.H. Frison; R.C. Froeschner; H.S. Fuller; D.P. Furman; F.M. Gaige; D.C. Geijskes; E.J. Gerberg; W.J. Gerhard; J.E. Gillaspy; F.C. Goble; P. Goodrum; D.J. Gould; D.R. Griffin; L.R. Guimarães; H. Hagan; D.G. Hall; D.E. Hardy; J.E. Hare; A.O. Haugen; K.G. Hayward; C.M. Herman; the late J.S. Hine; K.R. Hobbs; Mrs. Anita Hoffmann Sandoval; H. Hoogstraal; the late W. Horn; D.E. Howell; T.H. Hubbell; C.G. Huff; F.M. Hull; A.G. Humes; H.P. Hungerford; P.D. Hurd, Jr.; R.E. Hutchins; F.P. Ide; J.V. Irons; M.T. James; E.W. Jameson, Jr.; H.E. Jacques; W.L. Jellison; A.G. Johnson; the late C.W. Johnson; R.L. Jones; C.G. Kadner; the late H. Kahl; F. Keiser; E.L. Kessel; G.F. Knowlton; J.N. Knull; H. Knutson; G.M. Kohls; G. Kuschel; J.L. Laffoon; I. LaRivers; Mrs. Amelia R. Laskey; R. Latham; E.R. LeDune; L. Lee; R.D. Lee; D.B. Legters; the late Father Leopold; H.W. Levi; C.B. Lewis; F.J. Ligas; E. Lindner; A.W. Lindquist; J.M. Linsdale; L.S. Lippincott; W.M. Longhurst; H. de Souza Lopes; G.H. Lowery, Jr.; H.O. Lund; J.F. McAlpine; K.W. MacArthur; W.L. McAtee; A.T. McClay; H.E. McClure; D. MacCreary; W.A. McDonald; J.H. McDunnough; C.L. McGuigan; A. McIntosh; D.B. McMullen; J.A. Macnab; J. Maldonado Capriles; B. Malkin; the late J.R. Malloch; B. Mannheims; R.D. Maxwell; E.A. Mason; R. Matheson; A.R. Mead; R. Meinertzhagen; N.A. Meinkoth; G.C. Menzies; Mrs. Josephine R. Michener; C.E. Mickel; R.T. Mitchell; O.J. Murie; L.M. Murillo; R.C. Murphy; R.V. Nardy; L.R. Natvig; R.A. Norris; H. Oldroyd; O. Olsen; E. Osorno Mesa; the late J. Ouellet; R.H. Painter; C.E. Palm; the late R.R.

Parker; K.C. Parkes; P.W. Parmalee; C.T. Parsons; R.A. Paynter, Jr.; L.L. Pechuman; H.B. Peirson; L.R. Penner; I. Perez Vigueras; H.S. Peters; the late J.L. Peters; C.B. Philip; A.C. Phillips; F. Plaumann; the late C.E. Porter; J.E. Porter; R.L. Post; H.D. Pratt; E.W. Price; M.A. Price; the late W. Procter; W.F. Rapp; J.A.G. Rehn; J.W. Rehn; S. Renjifo Salcedo; G.B. Rich; A.G. Richards; H.G. Rodeck; the late F.M. Root; E.S. Ross; H.H. Ross; V.D. Roth; L.E. Rozeboom; S.M. Russell; C.W. Sabrosky; H. Sachtleben; C. Sanchez y Falcon; H.H. Schmidt; K.P. Schmidt; the late F.M. Schott; J.H. Schuurmans Stekhoven, Jr.; H.H. Schwardt; H.A. Scullen; G.A. Seaman; Y.S. Sedman; E. Séguy; H.C. Severin; F.R. Shaw; W.G. Sheldon; R.D. Shenefelt; G.E. Shewell; B. Shreve; C.N. Smith; Miss Marion E. Smith; O.E. Sousa; G.J. Spencer; R.M. Stabler; H.H. Stage; H.E. Stark; O.A. Stevens; A. Stone; R.W. Strandtmann; E.H. Strickland; the late M.H. Swenk; I.B. Tarshis; E.S. Thomas; G.W. Thomas; G.B. Thompson; L.H. Townsend; R. Traub; F.A. Urquhart; R.L. Usinger; J. VanTyne; W. Vogt; C. Wakeland; F.G. Wallace; G.E. Wallace; G.S. Walley; R.A. Ward; G.E. Watson, 3rd; N.A. Weber; R.L. Wenzel; A. Wetmore; W. Weyrauch; G.W. Wharton; W.E. Whitehead; J. Wilcox; F.X. Williams; A. Willink; F.H. Wilson; M.W. Wing; W.W. Wirth; G.N. Wolcott; H.B. Wood; M. Wood; S.F. Wood; and F. Zumpt. Also T.H.G. Aitken; D. Crocker; C.R. Hungerford; R.E. Wheeler; and F.N. Young.

I have been privileged to study the American Hippoboscidae of the following Museums and public collections. Dominion of Canada: Department of Agriculture (Division of Entomology), Ottawa; Canadian National Collection, Ottawa; Ontario Research Foundation, Toronto; Royal Ontario Museum of Zoology, Toronto; University of British Columbia, Vancouver; Department of Entomology, University of Alberta, Edmonton. — United States: Museum of Comparative Zoology, Cambridge, Mass.; former New England Museum of Natural History, Boston, Mass. (collection of Diptera now at Department of Biology, Boston University); Department of Tropical Research, New York Zoological Society, New York; American Museum of Natural History, New York; New York State Museum, Albany, N. Y.; former Insect Collection of Brooklyn Institute of Arts and Sciences; Department of Entomology, Cornell University, Ithaca, N. Y.; Academy of Natural Sciences, Philadelphia, Pa.; Reading Public Museum, Reading, Pa.; Carnegie Museum, Pittsburgh, Pa.; Patuxent Research Refuge, Laurel, Md.; Zoological Division, Agricultural Research Center, U.S. Department of Agriculture, Beltsville, Md.; United States National Museum, Washington, D. C.; Emory University, Emory, Ga.; State Plant Board of Mississippi, State College, Miss.; Texas State Board of Health, Austin, Tex.; Department of Entomology, Oklahoma Agricultural and Mechanical College, Stillwater, Okla.; Ohio State Museum, Columbus, O.; Chicago Museum of Natural History, Chicago, Ill.; Illinois State Natural History Survey, Urbana, Ill.; Museum of Zoology, University of Michigan, Ann Arbor, Mich.; Milwaukee Public Museum, Milwaukee, Wisc.; Department of Entomology, University of Wisconsin, Madison, Wisc.; Department of Entomology, University of Nebraska, Lincoln, Nebr.; Department of Biology, Iowa Wesleyan College, Mount Pleasant, Ia.; Department of Entomology (Snow Museum), University of Kansas, Lawrence, Ks.; Department of Entomology, Kansas State College, Manhattan, Ks.; University of Colorado Museum, Boulder, Colo.; Colorado State College, Fort Collins, Colo.; Utah State Agricultural College, Logan, Ut.; Department of Biology, University of Utah, Salt Lake City, Ut.; Museum of Northern Arizona, Flagstaff, Ariz.; Department of Entomology, University of Arizona, Tucson, Ariz.; Rocky Mountain Laboratory, Hamilton, Mont.; Oregon State Agricultural College, Corvallis, Ore.; Department of Zoology, State College of Washington, Pullman, Wash.; Department of Agriculture of California, Sacramento, Calif.; California Academy of Natural Sciences, San Francisco, Calif.; California Division

of Fish and Game, Berkeley, Calif.; Division of Entomology, University of California, Berkeley, Calif., Davis, Calif., and Los Angeles, Calif.; University Museum, Stanford University, Palo Alto, Calif. — Mexico: Escuela Nacional de Ciencias Biologicas, México, D. F. — Brazil: Instituto Oswaldo Cruz, Manguinhos, Rio de Janeiro. — England: British Museum (Natural History), London; University Museum, Cambridge; London School of Hygiene and Tropical Medicine. — Belgium: Institut Royal des Sciences Naturelles de Belgique, Brussels. — France: Muséum National d'Histoire Naturelle, Paris. — Sweden: Riksmuseum, Stockholm. —Finland: Universitetets Zoologiska Museum, Helsingfors. — Poland: Polish Zoological Museum, Warsaw. — Germany: Zoologische Sammlung des Bayerischen Staates, Munich; Zoologisches Institut, Halle a. S.; Staatliches Museum für Naturkunde, Stuttgart; Deutsches Entomologisches Institut, Berlin-Friedrichshagen (formerly at Berlin-Dahlem); Zoologisches Forschungsinstitut und Museum Alexander Koenig, Bonn. — Switzerland: Naturhistorisches Museum, Basel. — Italy: Museo Civico di Storia Naturale, Genoa. — Also Brazil: Departamento de Zoologia, Estado São Paulo, São Paulo.

SUPPLEMENTARY BIBLIOGRAPHY OF HIPPOBOSCIDAE

Anonymous 1939 Method of eradicating the sheep tick or fly. *Southwest. Sheep Goat Raiser*, **9**, No. 17, pp. 30–31.

1941*b* Resistance of sheep ked pupae to poisons. *Pastoral Rev. Graziers Rec.*, **51**, No. 11, p. 865.

1942*a* Use "ked" not "sheep tick." *Agric. Gaz. New South Wales*, **53**, No. 2, p. 76.

1942*b* Keds infestation heaviest in young sheep. Low condition in mature animals increases susceptibility. *Farmer's Weekly, Bloemfontein*, **63**, p. 777.

1945*b* Destruction of sheep ticks by dipping in dilute rotenone dips. *U.S. Dept. Agric., Bur. An. Ind., Zool. Div.*, 2 pp.

1951*a* Control of lice and sheep ticks on sheep and goats. *U.S. Dept. Agric., Agric. Res. Admin., Leaflet* **308**, 11 pp.

1951*b* Control cattle lice, cattle grubs, sheep ticks, garden insects with 1½% rotenone dust. *Wisconsin Agric. Coll. Ext., Spec. Circ.*, 4 pp.

1955*a* The Georg Statz Collection of fossil insects. *Ann. Ent. Soc. America*, **48**, p. 219.

Adachi, Marian S. 1954 Parasites of the native owl. *Proc. Hawaiian Ent. Soc.*, **15**, No. 2, p. 290.

Alexander, S.M.D. 1954 The birds of the Blasket Islands. *Bird Study, Oxford*, **1**, No. 4, pp. 148–168. (Hippoboscidae: p. 168).

Alford, S.W. 1940 Sheep pests and parasites. *Ann. Rept. Nebraska State Bd. Agric.*, pp. 511–513.

Armstrong, E.A. 1953 Nidicoles and parasites of the wren. *Irish Naturalists' Jl.*, **11**, pt. 3, pp. 57–64.

Ash, J. 1953 Notes on the puparial stage of some Hippoboscidae. *Ent. Mo. Mag.*, **89**, pp. 206–207.

1955 Some records of birds and mammal parasites. *Ent. Mo. Mag.*, **91**, pp. 64–65.

Auber, J. 1952 Note sur un Diptère pupipare, ses parasites et hyperparasites. *L'Entomologiste, Paris*, **8**, pts. 3–4, pp. 90–91.

Baker, J.R. 1955 Developmental stages of (a) *Haemoproteus* and (b) trypanosomes in *Ornithomyia*. *Trans. R. Soc. Trop. Med. Hyg.*, **49**, p. 11.

Becher, E. 1882 Zur Kenntniss der Kopfbildung der Dipteren. *Wien. Entom. Zeitg.*, **1**, pp. 49–54.

Beklemishev, V. N. 1954 (Parasitism of arthropods on terrestrial mammals. II. Fundamental trends of its development). *Med. Parazitol. i Parazitarnye Bolezni*, **1**, pp. 3–20. (In Russian. Hippoboscidae: pp. 9 and 11).

Benoit, P.L.G. 1955 Contributions à l'étude de la faune du Ruanda-Urundi (Mission P. Basilewsky, 1953). XXXVI. Diptera. Hippoboscidae. *Ann. Mus. Congo, Tervuren, 8vo, Sci. Zool.*, **36**, p. 317.

Bequaert, J. 1953*a* The Hippoboscidae or louse-flies of mammals and birds. Part I. Structure, physiology and natural history. *Entomologica Americana, (N.S.)*, **32**, (for 1952; published February 20, 1953), pp. 1–209; **33**, (for 1953; published May 26, 1953), pp. 211–442.

1953*b* Hippoboscidae and Nycteribiidae (Diptera Brachycera Cyclorrhapha). *Parc National Albert I, Mission G.F. de Witte* (1933–1935), Fasc. **79**, pt. 7, pp. 89–94.

1954 Hippoboscidae *Res. Norwegian Scient. Exped. Tristan da Cunha 1937–1938*, No. **26**, p. 45.

Bezzi, M. 1911 Etudes systématiques sur les Muscides hématophages du genre *Lyperosia*. *Arch. de Parasitologie*, **15**, pp. 110–143.

Biagi F., F. 1953 La leishmaniasis tegumentaria mexicana y algunos datos médico-estadísticos de Escárcega, Campeche. (Mexico), 119 pp.

Billberg, G.J. 1820 Enumeratio Insectorum in museo Billberg. (Stockholm), 138 pp.

Bogendörfer, L. 1949 Ueber die therapeutische Verwendung von Schafläusen bei Ikterus. *Klinische Wochenschr., Berlin*, **27**, pts. 3–4, p. 67.

1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna*, **45**, p. 31.

Bosman, S.W. 1949 Skaapluisvlieg rig subtiele skade aan. *Wolboer, Pretoria*, **18**, January No., pp. 6–8.

Bouvier, G.; Burgisser, H.; and Schneider, P.A. 1952 Observations sur les maladies du gibier, des oiseaux et des poissons en 1951. *Schweizer Arch. Tierheilk.*, **94**, pt. 7, pp. 475–479.

Brauer, F. 1863 Monographie der Oestriden. (Vienna), 292 pp., 10 Pls.

1869 Kurze Charakteristik der Dipteren-Larven zur Bekräftigung des neuen von Dr. Schiner entworfenen Dipteren-Systemes. *Verh. Zool.-Bot. Ver. Wien*, **19**, *Abhandl.*, pp. 843–852.

1880 Die Zweiflügler des kaiserlichen Museums zu Wien. I. *Denkschr. Ak. Wiss. Wien, Math.-Naturw. Kl.*, **42**, pp. 105–216, Pl. 6.

Buchner, P. 1953 Endosymbiose der Tiere mit pflanzlichen Mikroorganismen. (Basel), 771 pp., 3 Pls.

***Büttiker, W.** 1943 Die Lausfliegen der einheimischen Vögel. *Die Vögel der Heimat*, **13**, pt. 5.

1946 Die Parasiten und Nestbewohner des Alpenseglers (*Micropus melba L.*) *Die Vögel der Heimat*, **16**, No. 9, pp. 218–231.

1952 Methods of collecting parasites of birds. *The Ostrich*, **23**, No. 2, pp. 92–93.

Bursell, E. 1955 The polypneustic lobes of the tsetse larva (*Glossina*). *Proc. Roy. Soc., London, Ser. B, Biol. Sci.*, **144**, No. 915, pp. 275–286, Pls. 16–19. (*Hippobosca longipennis:* p. 285).

Burton, J.F. 1953 *Ornithomyia fringillina* Curt. on whitethroat. *Entom. Record*, **65**, pp. 59–60.

1954 Diptera notes from Kent, 1953. *Entom. Record*, **66**, p. 87.

Campbell, H.; and Lee, L. 1953*a* Studies on quail malaria in New Mexico and notes on other aspects of quail populations. *New Mexico Dept. Game Fish*, ix + 79 pp.

1953*b* Completion report. New Mexico Project W-41-R. "Distribution and management of avian malaria in New Mexico quail." (No place; mimeographed), 4 pp.

Carroll, J. 1953 Insect and allied parasites of farm stock. 1. Lice, sheep ked and sheep maggot flies. *Agric. Ireland*, **10**, pp. 271 and 273.

Chagnon, G. 1952 Études préliminaires sur les Diptères du Québec. *Contrib. Inst. Biol. Université Montréal*, No. 32, pp. 1–36.

Chilson, L.M. 1953 Insect records from Johnston Island. *Proc. Hawaiian Ent. Soc.*, **15**, pt. 1, pp. 81–84.

Clasohm, L.A. 1943 Sheep dipping. *Jl. Dept. Agric. South Australia*, **46**, pp. 327–328.

Cloudsley-Thompson, J.L. 1955 Parasitic flies. *Science Progress, London*, **43**, No. 172, pp. 616–628.

Cohen, E. 1955 "Parasitic flies." *Bird Study, Oxford*, **2**, No. 2, p. 97.

Coquillett, D.W. 1901*b* A systematic arrangement of the families of Diptera. *Proc. U.S. Nat. Mus.*, **23**, pp. 653–658.

Corbet, G.B. 1953 A flat-fly marking experiment. *Fair Isle Bird Obs. Bull.*, **1**, No. 12, pp. 45–48.

1955*a* Research on flat-flies at Fair Isle in 1954. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, pp. 313–317.

1955*b* Record of flat-flies from migrants at Fair Isle in 1954. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, pp. 321–322.

Corrêa, O. 1952 Dipteros pupiparos determinados no Rio Grande do Sul.

Sua patogenicidade e contrôle. *Bol. Dir. Prod. Anim., Rio Grande do Sul*, **8**, No. 13, pp. 3–7, 1 Pl.

d'Emden, P.H. 1953 Ked and lice control. *Tasmanian Jl. Agric.*, **24**, No. 2, pp. 137–140.

Detinova, T.S. 1955 (Age changes in the ovaries of the dog hippoboscid, *Hippobosca capensis* Olf.). *Dok. Akad. Nauk USSR*, **103**, p. 937–939. (In Russian).

Dogiel, V.A.; and Karolinskaia, K. 1936 (The parasitic fauna of the swifts (*Apus apus*). The question of the origin of the parasitic fauna of migratory birds). *Uchen. Zapiski Leningrad, Gosudarstv. Univ. Bubnov*, (7), *s. Biol.*, (3), pp. 49–79. (In Russian. *Crataerhina pallida:* pp. 73–74 and 79).

Donoso Barros, R. 1949 Observación de un caso de ectoparasitismo accidental del hombre, por *Olfersia fossulata* Macquart (1843). *Revista Médica Chile*, **77**, No. 6, p. 404.

Downes, J.A. 1952 The hippoboscid fly *Crataerina pallida* in Scotland. *Scottish Naturalist*, **64**, p. 166.

***Downing, W.; Harbour, H.E.; and Stones, L.C.** 1952 Modern insecticides and ectoparasite control. *Veter. Record*, **64**, pp. 787–803.

Dubinin, V.B. 1953 (Feather mites, Analgesoidea. II. Families Epidermoptidae and Freyanidae). *Fauna USSR, Arachnida*, **6**, No. 6, pp. 1–412. (In Russian).

Edwards, A.R.; and Stirling, W.T. 1953 Further records of *Crataerina pallida* (Latr.) in Scotland. *Scottish Naturalist*, **65**, p. 192.

Ennion, E.A.R. 1955 Flat-flies collected at Monkshouse bird observatory, Northumberland. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, p. 320.

Fethers, G. 1954 External parasites of sheep. *Pastoral Rev. Graziers Rec.*, **64**, pp. 1330–1331.

Figueroa Potes, A. 1953 Catálogo de los artrópodos de las clases Arachnida e Insecta, encontrados en el hombre, los animales y las plantas de la República de Colombia. III. *Acta Agron., Palmira*, **3**, pt. 1, pp. 1–7.

Furman, D.P.; and Tarshis, I.B. 1953 Mites of the genera *Myialges* and *Microlichus* from avian and insect hosts. *Jl. of Parasitology*, **39**, pt. 1, pp. 70–78.

Gil Collado, J. 1937 Sur le parasitisme de quelques Arthropodes de l'Espagne. *C.R. XIIe Congr. Internat. Zool., Lisbonne*, (1935), **3**, pp. 2061–2064.

1948 El melófago o falso piojo de las ovejas. *Agricultura, Madrid*, **17**, No. 198, pp. 450–453.

Gimingham, C.T. 1937 *Crataerina pallida* Latr., a parasite of the swift. *Proc. Ent. Soc. London, Sect. A*, **12**, pts. 10–12, p. 135.

Giovannoni, M.; Mello, M.J. de; and Nobrega, P. 1952 Ensaio de transmissão da toxoplasmose por insetos hematófagos. *Arq. Inst. Biol., São Paulo*, **21**, (1952–1954), No. 1, pp. 1–4.

Gleiser, C.A., and Yager, R.H. 1946 Trichomonad and *Haemoproteus* infections. *Bull. U.S. Army Med. Dept.*, **6**, No. 2, pp. 177–182.

Gouin, F. 1950 Evolution de la région clypéo-cibariale chez les Diptères brachycères. *Proc. VIIIth Intern. Ent. Congr., Stockholm*, (1948), pp. 554–556.

Gregson, J.D. 1953 Control of livestock insects in British Columbia by the new organic insecticides. *Proc. 7th Pacific Sci Congr., (New Zealand, 1949)*, **4**, pp. 185–188.

Gressitt, S.L. 1955 *Olfersia aenescens* Thompson. *Proc. Hawaiian Ent. Soc.*, **15**, No. 3, p. 375.

Handlirsch, A. 1920–1925 Systematisches Uebersicht. In *Schröder, Handbuch der Entomologie*, **3**, pp. 377–1143. (Hippoboscidae, pt. 18, 1925, pp. 1028–1030).

Hardy, D.E. 1954 *Prosthetochaeta fasciata* Grimshaw. *Proc. Hawaiian Ent. Soc.*, **15**, No. 2, p. 290.

Hare, J. E. 1953 Bionomics of *Lipoptena depressa* (Say), the common louse fly of deer in western North America. *Microentomology*, **18**, pt. 2, pp. 38–51, 3 Pls. (figs. 16–18).

Hausmann, — 1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna*, **45**, p. 31.

Hedeen, R.A. 1953 Ectoparasites occurring on mammals in the vicinity of Fort Hood, Texas. *Texas Jl. Sci.*, **5**, pt. 1 pp. 125–129.

Hennig, W. 1952 Die Larvenformen der Dipteren. 3. Teil. (Berlin), viii + 628 pp., 31 Pls. (Hippoboscidae: pp. 400–403).

Henry, M. 1945 The sheep ked. *Australian Vet. Jl.*, **21**, Nos. 5–6, p. 157.

Herman, C.M.; and Rosen, M.N. 1949 Disease investigations on mammals and birds by the California Division of Fish and Game. *California Fish Game*, **35**, pt. 3, pp. 193–201.

Herweijer, C.H. 1948 Onderzoek bestrijding van luisvliegen. *Nederl.-Indische Bladen Diergeneesk. Dierent.*, **55**, pts. 3–4, pp. 225–226.

Hightower, B.G.; Lehman, V.W.; and Eads, R.B. 1953 Ectoparasites from mammals and birds on a quail preserve. *Jl. of Mammalogy*, **34**, pp. 268–271.

Hill, R.E.; Hixson, E.; and Harris, L. 1954 Feeder lambs gain despite ticks. *Nebraska Agric. Expt. Sta. Q.*, **3**, *Summer Issue*, pp. 8–9.

Hill, R.E.; Hixson, E.; and Muma, M.H. 1950 Sheep tick control. *Nebraska Agric. Expt. Sta., Ann. Rept.*, **63**, p. 78.

Hindwood, K.A. 1952 Kookaburras and louse-flies. *The Emu*, **52**, p. 221.

Hiregaudar, L.S.; and Khambata, F.S. 1954 A record of mallophagan phoresy by *Pseudolynchia canariensis*. *Current Science, Bangalore*, **23**, p. 335.

Hoekstra, P. 1947 Proef ter verdelging van *Hipobosca* spec. (luisvlieg) by paarden met Shell Vetox. *Nederl. Ind. Bladen v. Diergeneeskunde*, **54**, pts. 3–4, pp. 95–97.

Hoffman, R.A. 1955 Longevity and emergence of the sheep ked. *Jl. Econ. Entom.*, **48**, p. 629.

Howard, H. 1955 The Los Angeles County Museum acquires Georg Statz Collection of fossils. *Bull. So. California Ac. Sci.*, **54**, pt. 2, p. 104.

Huff, C.G. 1931 Experimental transmission of an unusual *Haemoproteus* of mourning doves. *Jl. of Parasitology*, **18**, p. 122.

1942 Schizogony and gametocyte development in *Leucocytozoon simondi* and comparisons with *Plasmodium* and *Haemoproteus*. *Jl. Infect. Dis.*, **71**, pp. 18–32, 3 Pls.

Huitema, H. 1951 Een mogelijkheid voor de biologische bestrijding van luisvliegen. *Hemera Zoa*, **58**, pp. 443–453.

Hungerford, C.R. 1955 A preliminary evaluation of quail malaria in southern Arizona in relation to habitat and quail mortality. *Trans.* **20th** *North American Wildlife Confer.*, (*March, 1955*), pp. 209–219.

Imes, M.; and Babcock, O.G. 1943 Sheep ticks. *Sheep Goat Raiser*, **24**, No. 2, pp. 18–19 and 20.

Jackson, C.H.N. 1948 The eclosion of tsetse (*Glossina*) larvae. *Proc. Ent. Soc. London, Sec. A*, **23**, pts. 4–6, pp. 36–38, Pls. 1–8.

Jobling, B. 1949 Host-parasite relationship between the American Streblidae and the bats, with a new key to the American genera and a record of the Streblidae from Trinidad, British West Indies. *Parasitology*, **39**, pp. 315–329.

Kemper, H. 1952*a* ... Die Mauersegler-Lausfliege, Feind des Mauerseglers und Plage in menschlichen Wohnungen. *Natur und Volk*, **52**, pp. 404–408.

1952*b* Lausfliegen. *Entom. Colloquium*, No. **23**, 4 pp. (mimeographed).

1953 Ueber stechende Gliedertiere. *Schädlingsbekämpfung*, **45**, pp. 21–28.

1954 Beobachtungen an *Crataerina pallida*. *Verh. Deutsch. Ges. Angew. Entom., XII. Mitgl.-Vers.*, pp. 72–75.

Kemper, H.E. 1952 The control of external parasites of sheep. *Nation. Wool Grower*, **42**, pt. 7, pp. 21–23 and 39.

Kemper, H.E.; Cobbett, N.G.; and Peterson, H.O. 1953 Fluctuation of the ked population on sheep following shearing. *Veter. Medicine*, **48**, pp. 483–485.

Kemper, H.E.; Cobbett, N.G.; and Roberts, I.H. 1948 Test with benzene hexachloride for the destruction of coexistent infestations of the foot louse and keds on sheep. *North American Veter.*, **29**, No. 7, pp. 422–424.

Kemper, H.E.; and Peterson, H.O. 1953 The sheep tick and its eradication. *U.S. Dept. Agric., Farmers' Bull.* **2057**, 22 pp.

Kettle, D.S.; and Utsi, M.N.P. 1955 *Hypoderma diana* and *Lipoptena cervi* as parasites of reindeer (*Rangifer tarandus*) in Scotland. *Parasitology*, **45**, pts. 1–2, pp. 116–120.

***Kluz, —** 1950 (*Crataerina pallida* and *Stenepteryx hirundinis* in Czechoslovakia). *Sylvia*, **11–12**, pp. 37–51.

Knipling, E.F. 1951 The new insecticides for controlling external parasites of livestock. *U.S. Dept. Agric., Agric. Res. Admin., Bur. Entom. Plant. Quar.*, **E-762**, (2nd Revision), 28 pp.

1952 Benefits of ectoparasite control on livestock. *Proc. Amer. Assoc. Econ. Entom., North Central States Br.*, **7**, pp. 38–40.

Knowlton, G.F. 1953 Parasites on quail. *Bull. Brooklyn Ent. Soc.*, **48**, p. 19.

Knowlton, G.F.; Keetch, R.R.; and Binns, W. 1952 Controlling the sheep tick. *Utah State Agric. Coll., Ext. Circ.* **156**, 2 pp.

Kock, P. 1942 Zur Parasitenbefall des Rehwildes. *Deutsch. Tierärztl. Wochenschr.*, **50**, No. 3–4, pp. 36–38.

Koford, C.B. 1953 The California condor. *National Audubon Soc., Res. Rept. No.* **4**, 154 pp., Pls. (Occurrence of unidentified hippoboscid: p. 125).

Kraneveld, F.C.; and Mansjoer, M. 1952 Onderzoekingen over bloedparasieten. VI. Enkele gegevens over *Haemoproteus*-infecties bij *Columba livia* (*C. domestica*) in Indonesia. *Hemera Zoa*, **59**, Nos. 7–8, pp. 383–388.

Krauss, N.L.H. 1953 Insects and other invertebrates from Palmyra Atoll and Christmas Island. *Proc. Hawaiian Ent. Soc.*, **15**, pt. 1, pp. 217–220.

Lambrecht, K. 1933 Handbuch der Palaeornithologie. (Berlin), xix + 1024 pp.

Lameere, A. 1938 Précis de Zoologie. Vol. 5. Les insectes supérieurs. (Liege), 536 pp.

Latreille, P.A. 1802–1805 Histoire naturelle, générale et particulière, des Crustacés et des Insectes. (Paris), 14 vols. The following contain Hippoboscidae: vol. **2**, 1802 (An X), 380 pp.; vol. **3**, 1802 (An X), xii + 468 pp.; vol. **14**, 1805 (An XIII), 432 pp., Pls. 104–112.

1806–1809 Genera Crustaceorum et Insectorum secundum ordinem naturalem in familias disposita, iconibus exemplisque plurimis explicata. (Paris and Argentat), 4 vols. The following contains Hippoboscidae: vol. **4**, 1809, 399 pp., 16 Pls.

1817 Les Crustacés, les Arachnides et les Insectes. In *Cuvier, Le Règne Animal*, vol. 3, xxix + 653 pp.

1829 Suite et fin des Insectes. In *Cuvier, Le Règne Animal*, 2nd Ed., vol. **5**, xxiv + 556 pp.

Leach, W.E. 1817*c* Zoological Miscellany. (London), vol. 3, 151 pp., Pls. 121–149.

Legendre, R. 1952 Les adaptations morphologiques au parasitisme chez *Crataerhina pallida* Latr. *Annales Universitatis Saraviensis,* **1**, No. 2, pp. 118–121.

Linnaeus, C. 1758 Systema Naturae per regna tria naturae secundum classes, ordines, genera, species, cum characteribus, differentiis, synonymicis, locis. (Stockholm), 10th Ed., **1**, 824 pp.

Linsdale, J.M.; and Tomich, P.O. 1953 A herd of mule deer. A record of observations made on the Hastings Natural History Reservation. (Berkeley and Los Angeles), xiii + 567 pp.

Longhurst, W.M.; and Douglas, J.R. 1953 Parasite interrelationships of domestic sheep and Columbian black-tailed deer. *Trans.* **18th** *North Amer. Wildlife Confer.,* pp. 168–188.

Loria, J.V.V. 1944 La *Pseudolynchia maura* (Bigot) o "mosca de los palomares." *Almanaque Min. Agric. Nación Argentina,* **19**, pp. 209–211.

McClure, H.E. 1943 Ecology and management of the mourning dove, *Zenaidura macroura* (Linn.) in Cass County, Iowa. *Iowa Agric. Expt. Sta., Research Bull. No.* **310**, pp. 355–415.

McKenna, C.T.; and Fearn, J.T. 1952 (Continued, *Op. cit.,* pp. 441–449).

McLintock, J.; and Depner, K.R. 1954 A review of the life-history and habits of the horn-fly, *Siphona irritans* (L.). *Canad. Entom.,* **86**, pp. 20–33.

Mail, G.A. 1940 (Also in a French edition: "Le pou du mouton," 3 pp.).

Manwell, R.D. 1955 The blood Protozoa of seventeen species of sparrows and other Fringillidae. *Jl. of Protozoology,* **2**, No. 1, pp. 21–27. (*Ornithoica vicina* and *Ornithomyia fringillina:* p. 26).

***Markov, A.A.** 1940 (Seasonal and annual variations of the starling parasite fauna in connection with changes in meteorological factors). *Zool. Zhurnal,* **19**, pt. 5, pp. 741–750. (In Russian. *Ornithomyia chloropus:* p. 743).

Marsh, H. 1950*a* Parasites of sheep in Australia. *National Wool Grower,* **40**, No. 1, pp. 28–29.

1950*b* Cattle and sheep disease in Australia. *Jl. Amer. Vet. Med. Assoc.,* **96**, pp. 298–299.

Marshall, J.T., Jr. 1951 Vertebrate ecology of Arno Atoll, Marshall Islands. *Atoll Research Bull., No.* **3**, 38 pp. (mimeographed).

Massonnat, E. 1910 Un nouvel hôte de *Lynchia maura. C. R. Soc. Biol., Paris,* **68**, pp. 430–432.

Meeser, M.J.M. 1952 A preliminary survey of the endo- and ectoparasites of the impala, *Aepyceros melampus. Jl. South African Vet. Med. Assoc.,* **23**, No. 4, pp. 221–223.

Menon, P.B. 1955 Some observations on the biology of *Hippobosca* species, with special reference to the pupal period. *Proc. Indian Sci. Congr. Assoc.,* **42**, Pt. 3, *Abstracts,* p. 293.

Moreno, J.J. 1945 Garrapata de los lanares (*Melophagus ovinus*). *Almanaque Min. Agric. Nación Argentina,* **20**, p. 287. (Also: 1946, *Campo y Suelo Argent.,* **30**, No. 351, p. 6).

Morris, W.E.; Parten, H.L.; and Griffiths, H.J. 1950 Livestock pest control. *Minnesota Univ., Div. Agric. Ext., Ext. Folder* **147**, 8 pp.

Moul, E.T. 1954 Preliminary report on land mammals on Onotoa Atoll, Gilbert Islands. *Atoll Research Bull.,* No. **28**, 28 pp. (mimeographed).

Münch, W. 1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna,* **45**, p. 31.

Muir, F. 1912 Two new species of *Ascodipteron. Bull. Mus. Comp. Zool.,* **54**, pp. 349–366, Pls. 1–2.

Muma, M.H. 1946 Sheep tick control. *Nebraska Coll. Agric., Ext. Circ.* **1539**, (lithoprinted), [3 unnumbered pages].

Muma, M.H.; Hixson, E.; and Hill, R.E. 1950 Methods of sampling livestock parasite populations. *Proc. Amer. Assoc. Econ. Entom., North Central States Br.*, **5**, pp. 18–19.

Nair, S.R. 1926 A preliminary note on the binomics of the pigeon fly, *Lynchia maura* Bigot. *Proc.* **13th** *Indian Sci. Congr., (Bombay, Jan. 4–7)*, p. 190.

Nelson, W.A. 1953 The relationship between infestation of feedlot lambs with the sheep ked (*Melophagus ovinus* L.) and the nutritional status of the lambs. *Agric. Inst. Rev., Ottawa*, **8**, pt. 3, p. 34. (Also in: *Proc. Canadian Soc. Anim. Prod.*, 1953, pp. [17]–[18], mimeographed).

1955 Artificial feeding of certain ectoparasites through membranes. *Jl. of Parasitology*, **41**, pt. 6, pp. 635–636.

Nelson, W.A.; and Slen, S.B. 1953 Note on evaluating populations of the sheep ked, *Melophagus ovinus* (L), on feeder lambs. *Canadian Jl. Agric. Sci.*, **33**, pp. 620–621.

Newman, E. 1834 Attempted division of British insects into natural orders. *Entom. Mag.*, **2**, pp. 379–431.

Nielsen, P.; Ringdahl, O.; and Tuxen, S.L. 1954 Diptera 1. (exclusive of Ceratopogonidae and Chironomidae). In: *The Zoology of Iceland*, **3**, pt. 48*a*, pp. 1–189. (Hippoboscidae: pp. 140–141).

Nuorteva, P. 1950 (*Degeeriella glandarii* attached to *Ornithomyia fringillina* on *Garrulus glandarius* in Finland). *Annales Entom. Fennici*, **16**, pt. 1, pp. 34 and 38.

Owen, D.F. 1953 *Ornithomya fringilla* Curt. on redwing. *Entom. Record*, **65**, p. 31.

Paramonov, S.J. 1954 Notes on Australian Diptera. XIV. Notes on some hippoboscids (especially *Ortholfersia*). *Ann. Mag. Nat. Hist.*, (12), **7**, pp. 283–292.

Parmalee, P.W. 1952 Ecto- and endoparasites of the bobwhite: their numbers, species and possible importance in the health and vigor of quail. *Trans.* **17th** *North Amer. Wildlife Confer.*, pp. 174–188.

Parmalee, P.W.; and Price, M.A. 1953 *Bruellia illustris* (Kellogg) and other ectoparasites from the bobwhite quail in Texas. *Jl. of Parasitology*, **39**, pp. 222–223.

Parmenter, L. 1953 *Ornithomyia fringillina* Curt. on a robin in Kent. *Entom. Record*, **65**, p. 93.

Pfadt, R.E.; and DeFoliart, G.R. 1952 Control of sheep ked by dusting. *Wyoming Agric. Expt. Sta., Mimeogr. Circ.* **23**, 8 pp.

Pfadt, R.E.; Paules, L.H.; and DeFoliart, G.R. 1953 Effect of the sheep ked on weight gains of feeder lambs. *Jl. Econ. Entom.*, **46**, pp. 95–99.

Pfadt, R.E.; and Ryff, J.F. 1955 Safe use of dieldrin dust for sheep ked control. *Jl. Econ. Entom.*, **48**, pp. 195–198.

Philip, C.B. 1956 Comments on the classification of the Rickettsiales. *Canadian Jl. Microbiology*, **2**, pp. 261–270. (*Wolbachia melophagi*, p. 266).

Pilgrim, G.E. 1941 The dispersal of the Artiodactyla. *Biol. Reviews Cambridge Phil. Soc.*, **16**, pp. 134–163.

Poisson, H. 1931 Note sur un Diptère parasite des pigeons. *Bull. Soc. Path. Exot., Paris*, **24**, pp. 358–359.

Povolný, D.; and Rosický, B. 1955 (Faunistisch-bionomische Uebersicht der Hippobosciden aus dem Gebiete der ČSR). *Zoolog. Entom. Listy, Prague*, **4**, No. 1, pp. 5–20, Pls. 1–2. (In Czech).

Pratt, E. A. 1952 Keds, lice and mites in sheep. *New Zealand Jl. Agric.*, **85**, pp. 209 and 211–212.

***Proppe, G.J.** 1924 Bestrijding van de *Hippobosca*. *Nederl.-Indische Bladen Diergeneesk. Dierent.*, **35**, pp. 419–420.

Quecke, K. 1951 Die Behandlung der Gelbsucht mit Schafläusen. Ein

historischer Ueberblick. *Mediz. Monatsschr., Stuttgart,* **5**, No. 5, pp. 357–361.

Rausch, L. 1948–1949 Ueber die therapeutische Verwendung von Schafsläusen bei Ikterus. *Klinische Wochenschr., Berlin,* **26**, 1948, Nos. 29–30, pp. 475–476; **27**, 1949, Nos. 35–36, pp. 607–608.

Reyes, R.V. 1947 Artrópodos de interés médico-veterinario comprobados en Colombia. *Rev. Grancolombiana Zoot. Hig. Med. Vet., Caracas,* **1**, Nos. 10–12, pp. 698–721. (Also in: *Rev. Med. Vet., Bogotá,* **17**, No. 96, 1948, pp. 68–80).

Rivero, M.D.; and Ramirez, E. 1940 La infección por el *Haemoproteus columbae* en la investigación de la actividad antimalárica. *Rev. Inst. Salubr. Enfermed. Tropic., México,* **1**, pp. 245–264.

Robb, T.R. 1951 New method in battling old enemy: Wyoming sheepmen use modern way of controlling sheep tick to cut losses in herd. *Rec. Stockman, Annual Ed., (for 1952),* pp. 222 and 224.

Roberts, F.H.S. 1952 Insects affecting livestock; with special reference to important species occurring in Australia. (Sydney), vii + 267 pp.

Rude, C.S.; and Parish, H.E. 1946 Control of the sheep tick by a single dipping in DDT emulsion. *U.S. Bur. Ent. Plant Quarant.,* **E-679**, (mimeographed), 2 pp.

Samouelle, G. 1819 The entomologist's useful compendium, or an introduction to the knowledge of British insects. (London), 496 pp., 12 Pls. (First use of family name Hippoboscidae, p. 302, to include *Hippobosca, Ornithomyia, Craterina, Oxypterum* and *Melophagus*).

Schiner, J.R. 1853 Dipterologische Fragmente. III. *Verh. Zool.-Bot. Ver. Wien,* **3**, *Abhandl.,* pp. 151–154.

1864*b* Ein neues System der Dipteren. *Verh. Zool.-Bot. Ges. Wien,* **14**, *Abhandl.,* pp. 201–212.

Schuurmans-Stekhoven, J.H., Jr. 1923*b* (Title in Pt. I: appeared first in *Nederl.-Indische Bladen Diergeneesk. Dierent.,* **35**, pts. 2–3, pp. 103–144, 1 Pl.).

1954*a* De biologie van de luisvlieg van de duif (*Pseudolynchia canariensis* Macquart). *Entom. Ber. Nederl. Ent. Ver.,* **15**, No. 2, pp. 24–25.

1954*b* Biologische Beobachtungen an *Stenepteryx hirundinis* L. *Zeitschr. f. Parasitenk.,* **16**, pt. 4, pp. 313–321.

1955 Tweevleugelige Insecten, Diptera. III. Luisvliegen (Nycteribiidae en Hippoboscidae). *Kon. Nederland. Natuurhist. Vereen., Wetensch. Meded., No.* **16**, 16 pp.

Schuurmans-Stekhoven, J.H., Jr.; Silva, I.I.; and San Roman, P. 1954 Zur Biologie der Taubenlausfliege. *Zeitschr. f. Parasitenk.,* **16**, pts. 5–6, pp. 388–406.

1956 Die Biologie der Taubenlausfliege. Bewegungsphysiologie, Taxismen und Zirkulation des Blutes. *Zool. Jahrb., Abt. Physiol.,* **66**, pt. 4, pp. 509–530.

Seghetti, L. 1951 Sheep tick control. *Montana Wool Grower,* **25**, No. 4, p. 9.

Seghetti, L.; and Corkins, J.P. 1953 Control of sheep ticks. *Montana State Coll., Ext. Leaflet* **M-1**, (revised), 6 pp.

Séguy, E. 1950 Phorésie et rôle pathogène chez les Insectes Diptères. *Eos, Special Volume,* pp. 315–324.

1955 Introduction à l'étude biologique et morphologique des Insectes Diptères. *Publ. Avulsas Mus. Nacion., Rio de Janeiro,* pp. 1–260.

Sheldon, W.G.; Shaw, F.R.; and Bartlett, L.B. 1956 New records of hippoboscids on woodcock. *Proc. Ent. Soc. Washington,* **58**, No. 1, p. 13.

Shipley, A.E. 1911*b* Grouse disease. *Science Progress in 20th Century,* **5**, (1910–1911), No. 20, pp. 565–583. (Reprint, London, 1911, 15 pp.).

1917 Studies in insect life and other essays. (London), xi + 338 pp. (Grouse disease: pp. 189–221).

Simpson, C.F.; and Swarthout, E.W. 1954 *Haemoproteus columbae* infection in Florida pigeons. *Veter. Medicine*, **49**, pp. 491 and 494.

Simpson, G.L. 1953 The major features of evolution. (New York), xx + 434 pp.

Smart, J. 1945 Ked-flies. *Nature, London*, **155**, No. 3926, p. 123.

Snodgrass, R.E. 1944 The feeding apparatus of biting and sucking insects affecting man and animals. *Smithson. Misc. Coll.*, **104**, No. 7, pp. 1–113.

1953 The metamorphosis of a fly's head. *Smithson. Misc. Coll.*, **122**, No. 3, pp. 1–25.

Soetisno, M. 1928 Een vijand der luisvliegen. *Nederl.-Indische Bladen Diergeneesk. Dierenteelt*, **40**, pp. 231–232.

Stansfield, G. 1955 Flat-fly infestation in the pipits and wheatears of Skokholm in 1954. *Fair Isle Bird Obs. Bull.*, **2**, No. 7, pp. 318–320.

Statz, G. 1941 Plagegeister aus dem rheinischen Braunkohlenwalde. *Rheinischer Naturfreund*, **5**, No. 1; (reprint, pp. 1–16).

Stephen, A.C. 1953 Magnificent frigate-bird in Scotland. *Scottish Naturalist*, **65**, No. 3, pp. 193–194. Postscript by the Editors, p. 156. (*Olfersia spinifera*).

Stevenson, A.C. 1922 [Negri-like bodies in cells of the sheep-ked]. *Trans. R. Soc. Trop. Med. Hyg.*, **16**, pts. 1–2, p. 19.

Stirling, W.T. 1953 Further records of *Crataerina pallida* (Latr.) in Scotland. *Scottish Naturalist*, **65**, No. 3, p. 192.

Strickland, E.H. 1953 The ptilinal armature of flies (Diptera Schizophora). *Canadian Jl. Zool.*, **31**, No. 3, pp. 263–299.

Tarshis, I.B. 1953*a* Oöcyst-like bodies in the midgut of *Stilbometopa impressa* (Bigot). *Science*, **118**, pp. 199–202.

1953*b* The transmission of *Haemoproteus lophortyx* O'Roke of the valley California quail by hippoboscid flies of the species *Stilbometopa impressa* (Bigot) and *Lynchia hirsuta* Ferris and elucidation of the biology of these ectoparasites. (*Summary of Dissertation, Berkeley*), 1 p.

1954 Transporting live hippoboscids. Psyche, **61**, pp. 58–62.

1955 Transmission of *Haemoproteus lophortyx* O'Roke of the California quail by hippoboscid flies of the species *Stilbometopa impressa* (Bigot) and *Lynchia hirsuta* Ferris. *Experimental Parasitology*, **4**, No. 5, pp. 464–492.

Tendeiro, J. 1950 Subsídios para o conhecimento da entomofauna parasitária de Moçambique. *Anais Junta Investigações Coloniais, Lisboa*, **4**, pt. 2, pp. 123–152, Pls. 1–2.

Théodoridès, J. 1954 Première contribution à l'étude des ectoparasites des Vertébrés des Pyrénées-Orientales. *Vie et Milieu, Paris*, **4**, (for 1953), pt. 4, pp. 753–756.

Thompson, G.B. 1953*a* Contributions toward a study of the ectoparasites of British birds and mammals. No. 1. *Ann. Mag. Nat. Hist.*, (12), **6**, pp. 401–425.

1953*b* The parasites of British birds and mammals. XXV. Additional notes on *Crataerina pallida* (Latr.). *Ent. Mo. Mag.*, **89**, pp. 208–209.

1954*a* Contributions towards a study of the ectoparasites of British birds and mammals. No. 2. *Ann. Mag. Nat. Hist.*, (12), **7**, pp. 17–39.

1954*b* Contributions toward a study of the ectoparasites of British birds and mammals. No. 3. *Ann. Mag. Nat. Hist.*, (12), **7**, pp. 438–447.

1955*a* The parasites of British birds and mammals. XXVIII. Records of *Ornithomya* spp. collected during 1952. *Ent. Mo. Mag.*, **91**, pp. 4–5.

1955*b* Contributions toward a study of the ectoparasites of British birds and mammals. No. 4. *Ann. Mag. Nat. Hist.*, (12), **8**, pp. 25–35.

1955*c* Ectoparasites from birds at Bardsey. *Bardsey Observatory*, (*1954 Rept.*), p. 11.

1955*d* The collection of bird ectoparasites at the bird observatories. *British Birds*, **48**, pp. 239–240.

1955*e* Ectoparasites. *Lundy Field Soc. Rept.*, (*for 1954*), pp. 30–31.

1955*f* Ectoparasites from Skokholm Bird Observatory. *Nature in Wales*, **1**, No. 3, pp. 128–130.

1955*g* Contributions toward a study of the ectoparasites of British birds and mammals. No. 5. *Ann. Mag. Nat. Hist.*, (12), **8**, pp. 724–730.

1955*h* Contributions towards a study of the ectoparasites of British birds and mammals. No. 6. *Ann. Mag. Nat. Hist.*, (12), **8**, pp. 917–927.

Trouessart, E.L. 1906 [First description of *Myialges anchora*]. *Bull. Soc. Zool. France*, **31**, No. 5, pp. 128–129.

Vogelsang, E.G. 1936 Contribución al estudio de la parasitología animal en Venezuela. V. Ectoparásitos. *Rev. de la Policlinica Caracas*, **6**, No. 31, pp. 2.122–2.124.

1953 Beiträge zur Kenntnis der Zooparasiten der Haus- und Wildtiere Venezuelas. *Deutsch. Tierärztl. Wochenschr.*, **60**, pp. 529–531.

Vorobev, M.M.; and Kishkar, P.M. 1954 (Controlling the sheep ked). *Karakulevodstvo i Zverovodstvo*, **7**, pp. 54–55. (In Russian).

Wahl, B. 1914 Ueber die postembryonale Entwicklung des Fliegenkopfes. *Verh. Zool.-Bot. Ges. Wien*, **64**, *Sitzungsber.*, pp. 202–205.

Ward, R.A. 1953 Additional record of phoresy of Mallophaga on Hippoboscidae. *Bull. Brooklyn Ent. Soc.*, **48**, p. 128.

Wasserburger, H.J. 1953 Versuche zur Schaflausfliegenbekämpfung. *Deutsch. Tierärztl. Wochenschr.*, **60**, pp. 475–476.

Waterhouse, D.F. 1953 The occurrence and significance of the peritrophic membrane, with special reference to adult Lepidoptera and Diptera. *Australian Jl. Zool.*, **1**, pt. 3, pp. 299–318, Pls. 1–2.

Westwood, J.O. 1839–1840 An introduction to the modern classification of insects. (London), vol. 1, 1839, xii + 462 pp., 1 Pl.; vol. 2, 1840, xi + 587 pp. and Generic Synopsis of 158 pp.

Whiting, F.; Nelson, W.A.; Slen, S.B.; and Bezeau, L.M. 1954 The effects of the sheep ked (*Melophagus ovinus* L.) on feeder lambs. *Canadian Jl. Agric. Sci.*, **34**, pp. 70–75.

Whittle, C.L. 1932 Are nesting territories always available for returning juvenile song sparrows? *Bird-Banding*, **3**, No. 3, pp. 106–108. (Hippoboscidae: p. 107).

Wigand, R.; and Hente, H. 1950 Ueber die therapeutische Verwendung der Schaflausfliege gegen Ikterus. *Hippokrates*, **21**, pp. 662–664.

Williamson, K. 1951 Bird ectoparasites. *Fair Isle Bird Observatory Bull.*, **1**, pp. 6–7.

1954 The Fair Isle apparatus for collecting bird ectoparasites. *British Birds*, **47**, pt. 7, pp. 234–235, Pl. 44.

Williamson, K.; and Thom, V.M. 1955 Red-footed falcon at Fair Isle. *British Birds*, **48**, pp. 542–543.

Wilms, F. 1950 Therapeutische Anwendung von Schafläusen bei Hepatitis epid. *Mediz. Klinik, Berlin-Munich-Vienna*, **45**, p. 31.

Woke, P.A.; Jacobs, L.; Jones, Frances E.; and Melton, Marjorie L. 1953 Experimental results of possible arthropod transmission of toxoplasmosis. *Jl. of Parasitology*, **39**, pp. 523–532.

Woodbury, E.N. 1943 Rearing insects affecting man and animals. *Amer. Assoc. Adv. Sci., Publ. No.* **20**, pp. 60–73. (*Melophagus ovinus:* pp. 72–73).

Woodcock, H.M. 1923 [Rickettsia-like bodies in the ked]. *Trans. R. Soc. Trop. Med. Hyg.*, **17**, pts. 1–2, pp. 4–5.

Woodroffe, G.E. 1953 An ecological study of the insects and mites in the

nests of certain birds in Britain. *Bull. Ent. Res.*, **44**, pt. 4, pp. 739–772, Pls. 14–16.

Wulp, F.M. van der; and Meijere, J.C.H. de 1898 Nieuwe naamlijst van Nederlandsche Diptera. *Tijdschr. v. Entom.*, **41**, *Supplement*, [6] + 149 pp. (Hippoboscidae: pp. 142–143).

Zimsen, Ella 1954 The insect types of C.R.W. Wiedemann in the Zoological Museum in Copenhagen. *Skrift. Univ. Zool. Mus., Copenhagen*, **14**, pp. 1–43. (Type of *Ornithomyia columbae:* p. 30).

ADDITIONS AND CORRECTIONS

Part I

(p. 13) Dr. Richard K. Benjamin informs me that he was not a Graduate Student when he did research work at the Biological Laboratories of Harvard University. He was at the time a National Research Fellow, having obtained his Doctor's degree earlier. I regret that I was under a misapprehension in this matter.

(p. 21) Fig. 5*C* is incorrect; a corrected drawing of the frontal area and antennae of *Ornithoica vicina* is given in Pt. II, Fig. 24*G* (p. 104).

(p. 22, line 12 from top) For "Hippobosciade," read "Hippoboscidae."

(pp. 28–29) Fig. 7*F* is incorrect; a corrected drawing of the frontal area and antennae of *Olfersia coriacea* is given in Pt. II, Fig. 84*B* (p. 421).

(p. 32, line 7 from bottom) For "medium notal suture," read "median notal suture."

(pp. 46–47) In the caption for Fig. 13*D*, for "1, 2, 3, and 4, first, second, third and fourth longitudinal veins," read "1, 2, 3 and 4, first, fourth, fifth and sixth longitudinal veins."

(p. 60, line 16 from top) Delete "*Ornithomyia laticornis* Macquart, 1835." This is not a synonym of *Ornithoctona erythrocephala.*

(p. 121, bottom line) For "15°17′ N.," read "51°17′ N."

(p. 124, line 6 from top) For "*M. ovinus* is the hippoboscid which reaches," read "*M. ovinus* is one of 2 hippoboscids which reach."

(p. 138, line 8 from bottom) For "*sacharowi*," read "*sacharovi.*"

(p. 141, lines 1 and 2 from top) For "*Anhinga r. rufa*," read "*Anhinga anhinga rufa.*"

(pp. 140–141) Laboulbeniales of the genus *Trenomyces* have been observed recently also on *Lynchia holoptera, Olfersia sordida,* and *O. coriacea.* These fungi were all seen by Dr. R.K. Benjamin.

(pp. 142–149) Valuable observations on the mites attacking hippoboscids have been published recently by Dubinin (1953) and by Furman and Tarshis (1953).

(p. 147, line 20 from bottom) For "Waterston," read "Warburton."

(p. 160, line 23 from top) For "*haliaeëtus*," read "*haliaetus.*"

(p. 161) The name *Mormoniella vitripennis* (Walker) should be corrected to *Nasonia vitripennis* (Walker), as explained in Pt. II, p. 403.

(p. 167, last sentence of first paragraph) Mr. G.H.E. Hopkins called my attention to the fact that *Hohorstiella* belongs in the Amblycera, so that the generalization of this sentence is invalid.

(p. 194, third paragraph) The sentence referring to the puparium of *Lynchia albipennis* should be deleted. See Pt. II, p. 341, footnote.

(p. 216, lines 3 and 4 from bottom) Delete "a louse occurring normally on the European robin, *Turdus merula.*"

(pp. 238–239) The discussion of *Lynchia americana* and *L. fusca* should be emended, as these two names are now referred to one species. See Pt. II, pp. 297–299.

(p. 249, line 14 from bottom) For "marine," read "aquatic."

(p. 252, line 13 from top) For "*Theresticus,*" read "*Theristicus.*"

(p. 252, line 6 from bottom) For "*massonati,*" read "*massonnati.*"

(p. 270, line 8 from top) For "strictly," read "frequently." Mr. G.H.E. Hopkins informed me that some of the Alcedinidae, such as *Dacelo, Ceyx, Lacedo* and *Todiramphus,* are insectivorous. *Dacelo* also eats snakes and lizards. The fact may be of some importance for the host-parasite relations, as the hippoboscids known at present from Alcedinidae were taken only on the genera which do not eat fish.

(p. 279, line 12 from top) For "*Tachyphorus,*" read "*Tachyphonus.*"

(p. 321) Delete *Lynchia fusca* from the group of pleioxenous hippoboscids, as it is a synonym of the polyxenous *L. americana* discussed on p. 323.

(p. 345) Add to the hippoboscids definitely known to bite Man in nature: *Olfersia aenescens* C.G. Thomson and *O. fossulata* Macquart, as mentioned in Pt. II for these species.

(p. 327, line 2 from bottom) For "*Ornithomyia remota,*" read "*Ornithomyia parva* (=*remota*)." The name should be corrected wherever it occurs.

(p. 368, line 15 from top) For "1905," read "1904–1905." The pages of this work covering the Hippoboscidae were published Dec. 1, 1904.

(p. 373, line 14 from top) For "1944*b*," read "1943;" but the paper with the same title in the *Wyoming Wool-Grower* appeared in 1944.

(p. 385, lines 16 and 18 from bottom) For "*Papeis,*" read "*Papéis.*"

(p. 397, lines 20 and 28 from bottom) For "Massonat," read "Massonnat." This name was misspelled throughout Pt. I and should be corrected wherever it occurs.

(p. 399, line 14 from top) For "Morey," read "Morley."

(p. 408, line 6 from top) For "128–220," read "127–223."

Part II

(p. 6) Dr. C.W. Sabrosky pointed out to me that the earliest use of the family term Hippoboscidae for the true louse-flies was by Samouelle (1819, pp. 302–303), who included in it *Hippobosca, Ornithomyia, Craterina, Oxypterum* and *Melophagus.* He placed *Nycteribia* in a distinct family Nycteribiidae. Both these families he placed in the Omaloptera of Leach.

(p. 18) Add to the characters of the Ortholfersiinae: "Arista of antenna long, thin, seta-like, undivided."

(p. 22, line 12 from top) For "ellipical," read "elliptical."

(p. 22) The first entry of couplet 14 in the key, leading to *Hippobosca,* should read: "Anterior margin of thorax seen from above broadly rounded off at the sides."

(pp. 93–100) Additional specimens examined of *Ornithoica vicina.* Massachusetts: Cotuit, Barnstable Co., on *Melospiza m. melodia,* Sept. 19 (B. Shreve). — New Jersey: 3 miles N. of New Brunswick, on *Pipilo e. erythrophthalmus,* Sept. (J. Baird). — Tennessee: Nashville, Davidson Co., on *Pipilo e. erythrophthalmus,* Nov. 1 (Mrs. A.R. Laskey). — West Virginia: 3 miles N. of Arbovale, Pocahontas Co., 2 ♀ on *Lanius ludovicianus migrans,* Aug. 12; this bird also harboring 7 *Ornithomyia fringillina* (K.C. Parkes). — Mexico: El Ocote, Ocozocoautla, State Chiapas, on *Otus g. guatemalae* (M. Alvarez del Toro). — British Honduras: Maya Mts., on *Ciccaba nigrolineata* (S.M. Russell). — Panama: Cerro Picacho, Chiriqui Prov., 6200 ft., on *Myiodynastes hemichrysus* (G. Hartmann and A. Wetmore). — Colombia: La Candela, Dept. Huila, on *Ciccaba v. virgata* (M.A. Carriker, Jr.). — Brazil: Nova Teutonia, Itá, State Santa Catharina, on *Glaucidium b. brasilianum* (F. Plaumann). — Bolivia: Ipirana, South Yungas, on *Tyto alba tuidara* (Kunzel and Niethammer).

(pp. 100–102) Add to list of Nearctic hosts under Passeriformes: *Lanius ludovicianus migrans* (1).

(p. 102) Add to list of Neotropical hosts under Strigiformes: *Ciccaba*

nigrolineata (1); *C. v. virgata* (1); *Glaucidium b. brasilianum* (1); *Otus g. guatemalae* (1); *Tyto alba tuidara* (1). Under Passeriformes: *Myiodynastes hemichrysus* (1).

(p. 122) Add to the references of *Ornithomyia fringillina:* Sheldon, Shaw, and Bartlett, 1956, Proc. Ent. Soc. Washington, **58**, p. 13 (Massachusetts: Prescott Peninsula area of Quabin Reservoir, near Shutesbury, on *Philohela minor*).

(pp. 125–133) Additional specimens examined of *Ornithomyia fringillina.* ALASKA: Dot Lake Lodge, between Tok and Delta Junction, about 63°30′ N., 144° W., Aug. 31, without host (W.H. Coleman). — MAINE: Waterville, Kennebec Co., on a warbler, Sept. 13 (D. Crocker). — MASSACHUSETTS: Prescott Peninsula, Quabin Reservoir, Shutesbury, Hampshire Co., 2 ♀ on *Philohela minor,* Aug. 15–16 (L.M. Bartlett. — Also recorded by Sheldon, Shaw and Bartlett, 1956). — NEW JERSEY: 3 miles N. of New Brunswick, on *Cyanocitta c. cristata,* Sept. (J. Baird). — WEST VIRGINIA: 3 miles N. of Arbovale, Pocahontas Co., on *Lanius ludovicianus migrans,* Aug. 12, 7 ♀; 3 or 4 more flies escaped from this bird (K.C. Parkes). — WISCONSIN: Cedar Grove, Sheboygan Co., Sept. 22, on *Accipiter striatus velox* (D.D. Berger). — Also MASSACHUSETTS: Groton, Middlesex Co., on *Passerina cyanea,* Sept. 11 (W.P. Wharton); Weymouth, Norfolk Co., on *Molothrus a. ater,* Sept. 9 (R.E. Wheeler).

(p. 136) Add to list of hosts under Passeriformes: *Lanius ludovicianus migrans* (1); *Passerina cyanea* (1).

(p. 141, line 3 from bottom) For "*Pipilo fuscus falcifer,*" read "*Pipilo maculatus falcifer.*"

(p. 156) Additional record of *Ornithomyia* (*Pseudornithomyia*) *ambigua* (Lutz, Neiva and da Costa Lima). COLOMBIA: Belén, Dept. Huila, 6300 ft., on *Notiochelidon c. cyanoleuca* (M.A. Carriker, Jr.)

(p. 162) Add to the synonymy of *Crataerina: Crathaerrhyna* Beklemishev, 1954, Med. Parazitol. i Parazitarnye Bolezni, **1**, p. 9 (error for *Crataerina*).

(pp. 190–197) Additional specimens examined of *Ornithoctona erythrocephala.* MEXICO: Laguna Ocotal, State Chiapas, on *Penelope p. purpurascens,* 4 *Ortalis v. vetula, Hypomorphnus urubitinga ridgwayi,* and *Micrastur semitorquatus naso* (R.A. Paynter, Jr.); Rancho Nuevo Mundo, Pueblo Nuevo Solistahuacán, State Chiapas, 1900 m., on *Pharomachrus m. mocino* (M. Alvarez del Toro); El Ocote, Ocozocoautla, State Chiapas, on *Oreopeleia m. montana* (M. Alvarez del Toro). — PANAMA: Palo Santo, Chiriqui Prov., on *Buteo p. platypterus* (G. Hartmann and A. Wetmore); Santa Clara, Chiriqui Prov., on *Odontophorus guianensis castigatus* (G. Hartman and A. Wetmore). — JAMAICA: Clydesdale, St. Andrew, on Man (A.M. Wiles); Second Breakfast Spring, St. Andrew, in flight (T.H. Farr); Deanery, St. Catherine, ♀ with 10 ♀ mites, without eggs, fixed on the gula, in the rostrum membrane behind the haustellum and ♂ with 1 ♀ mite, without eggs, in the same position, on *Columba i. inornata.* — COLOMBIA: Tyeros (Moscopán), Dept. Huila, on *Herpetotheres c. cachinnans* (M.A. Carriker, Jr.); Hacienda Potreros, 15 miles S.W. of Frontino, Dept. Antioquia, on *Columba subvinacea bogotensis* (M.A. Carriker, Jr.); La Candela, Dept. Huila, on *Odontophorus hyperythrus* (M.A. Carriker, Jr.); La Bodega, Dept. Antioquia, on *Momotus momota aequatorialis* (M.A. Carriker, Jr.). — PERU: Hacienda Taulis, 6°50′ S., 79°10′ W., 1700 m., on *Chondrohierax uncinatus* (Koepcke); Río Lurin, on *Falco sparverius peruvianus* (W. Weyrauch). — BOLIVIA: Irupana, 200 kilom. E. of La Paz, South Yungas, 2000 m., on *Columba a. albilinea,* and 6 ♀ and 1 ♂ on *Buteo brachyurus* (Kunzel and Niethammer). — URUGUAY: Montevideo, on *Buteo magnirostris gularis* (L.P. Barattini); Rocha, on *Buteo magnirostris gularis* (L.P. Barattini). — ARGENTINA: Pampa de los Guanacos, Santiago del Estero, near Roque Saenz Peña, on *Falco f. femoralis,* April 16 (J. Gomez). — BRAZIL: Nova Teutonia near Itá, State Santa Catharina, on *Circus cinereus* and *Columba rufina sylvestris* (F. Plaumann).

(p. 198) Add to list of Neotropical hosts under Falconiformes: *Buteo brachyurus* (1); *B. magnirostris gularis* (2); *B.p. platypterus* (1); *Chondrohierax uncinatus* (1); *Falco sparverius peruvianus* (1); *Hypomorphnus urubitinga ridgwayi* (1); *Micrastur semitorquatus naso* (1). Under Galliformes: *Odontophorus guianensis castigatus* (1); *O. hyperythrus* (1); *Ortalis v. vetula* (4); *Penelope p. purpurascens* (1). Under Columbiformes: *Columba subvinacea bogotensis* (1). Under Trogoniformes: *Momotus momota aequatorialis* (1). This raises the number of native Neotropical host species to 106 (34 Falconiformes, 12 Galliformes, and 22 Columbiformes). It would therefore appear that the Galliformes will have to be included among the true breeding hosts of *O. erythrocephala*, particularly in view of the fact that hippoboscids are difficult to obtain from such birds.

(pp. 212–216) Additional specimens examined of *Ornithoctona fusciventris*. MEXICO: Laguna Ocotal, State Chiapas, on *Icterus m. mesomelas*, *Piranga l. leucoptera*, and *Dendroica graciae decora* (R.A. Paynter, Jr.). — PANAMA: Cerro Punta, Chiriqui Prov., on *Dendrocopos villosus extimus* and *Pezopetes capitalis* (G. Hartmann and A. Wetmore); Santa Clara, Chiriqui Prov., on *Momotus m. momota* and *Odontophorus guianensis castigatus* (G. Hartmann and A. Wetmore); Silla de Cerro Pando, El Volcán, Chiriqui Prov., 5200 ft. on *Empidonax flaviventris* and *Myadestes ralloides melanops* (G. Hartmann and A. Wetmore); Palo Santo, Chiriqui Prov., on *Turdus grayi casius* (G. Hartmann and A. Wetmore); Chevo, Chiriqui Prov., on *Mitrephanes phaeocercus aurantiiventris* (G. Hartmann and A. Wetmore); El Volcán, Chiriqui Prov., on *Pharomachrus mocino costaricensis* (A. Wetmore). — COLOMBIA: Hacienda La Ellusión, above Urrao, 9000 ft., Dept. Antioquia, on *Atlapetes s. schistaceus* (M.A. Carriker, Jr.); Belén, Dept. Huila, 6400 ft., on *Anabacerthia s. striaticollis* (M.A. Carriker, Jr.); La Candela, Dept. Huila, on *Micrastur semitorquatus naso* and *Myiochanes fumigatus ardosiacus* (M.A. Carriker, Jr.); La Bodega, Dept. Antioquia, on *Calospiza l. labradorides* (M.A. Carriker, Jr.); Paramo de Sonson, Dept. Antioquia, 8500 ft., on *Myiotheretes s. striaticollis* and *Atlapetes s. schistaceus* (M.A. Carriker, Jr.); Purace, Dept. Cauca, 9000 ft., on *Leptotila p. plumbeiceps* (M.A. Carriker, Jr.) — PERU: Hacienda Taulis, 6°50′ S., 79°10′ W., 1700 m., Cajamarca, on *Atlapetes torquatus nigrifrons* (Koepcke). — BOLIVIA: Irupana, 200 kilom. E. of La Paz, South Yungas, 2000 m., on *Coryphospingus cucullatus fargoi* (Kunzel and Niethammer); Pojo, 150 kilom. E. of Cochabamba, Dept. Cochabamba, on *Poospiza t. torquata* (Niethammer).

(pp. 216–217) Add to list of Neotropical hosts under Falconiformes: *Micrastur semitorquatus naso* (1). Under Galliformes: *Odontophorus guianensis castigatus* (1). Under Coraciiformes: *Momotus m. momota* (1). Under Passeriformes: *Anabacerthia s. striaticollis* (1); *Atlapetes s. schistaceus* (2); *A. torquatus nigrifrons* (1); *Calospiza l. labradorides* (1); *Coryphospingus cucullatus fargoi* (1); *Dendroica graciae decora* (1); *Empidonax flaviventris* (1); *Icterus m. mesomelas* (1); *Mitrephanes phaeocercus aurantiiventris* (1); *Myadestes ralloides melanops* (1); *Myiochanes fumigatus ardosiacus* (1); *Myiotheretes s. striaticollis* (1); *Pezopetes capitalis* (1); *Poospiza t. torquata* (1); *Turdus grayi casius* (1). Columbiformes: *Leptotila p. plumbeiceps* (1). Trogoniformes: *Pharomachrus mocino costaricensis* (1). Piciformes: *Dendrocopos villosus extimus* (1). This raises the number of known Neotropical host species to 65 (2 Falconiformes; 2 Galliformes; 1 Columbiformis; 1 Trogoniformis; 1 Piciformis; and 58 Passeriformes), a further proof that passerine birds are the true breeding hosts of *O. fusciventris* (with 66 of 75 verified individual records).

(p. 225) Additional specimen examined of *Ornithoctona oxycera*. COLOMBIA: Cerro Munchique, Dept. Cauca, 7500 ft., on *Cnemotriccus p. poecilurus* (M.A. Carriker, Jr.).

This record adds one host species in Passeriformes: *Cnemotriccus poecilurus*.

(p. 228) Additional specimens examined of *Ornithoctona (Ornithopertha) nitens.* PANAMA: El Volcán, Chiriqui Prov., 4 ♀ on *Pharomachrus mocino costaricensis* (A. Wetmore); this bird also harbored 2 *Ornithoctona fusciventris.* — COLOMBIA: Belén, Dept. Huila, 6400 ft., on *Trogon p. personatus* (M.A. Carriker, Jr.).

(p. 241) Additional specimen examined of *Stilbometopa impressa.* CALIFORNIA: Jacumba, San Diego Co., Oct. 23 (A.D. Atnip and R.J. Symonton).

(p. 247) Additional specimen examined of *Stilbometopa podopostyla:* BRITISH HONDURAS: Gallon Jug, on *Leptotila* sp., 1 ♀ with a Mallophagan attached to the under side near outer apex of right coxa; first case of phoresy of lice reported for *S. podopostyla* (S.M. Russell).

(p. 252) Additional specimens examined of *Stilbometopa fulvifrons.* ISLE OF PINES: Pasodita, 2 ♀ on *Saurothera merlini decolor,* Oct. 21 (G.E. Watson III).

Add to list of hosts under Cuculiformes: *Saurothera merlini decolor* (1). This raises the number of known native host species to 8.

(p. 276) Additional specimens examined of *Lynchia americana* (Leach). MASSACHUSETTS: Brookline, on *Accipiter striatus velox* (G.A. Reagh). — ARGENTINA: Río del Valle, Depto. Anta, Prov. Salta, on *Pulsatrix perspicillata boliviana* (S. Pierotti). — BRAZIL: Nova Teutonia near Itá, State Santa Catharina, on *Glaucidium b. brasilianum* (F. Plaumann).

(p. 305) Additional specimen examined of *Lynchia latifacies.* COLOMBIA: La Capilla, Dept. Cauca, 6100 ft., 1 ♀ on *Piaya cayana nigricrissa* (M.A. Carriker, Jr.). This interesting record extends the range of the species to Colombia and adds a second species of Cuculiformes to the host list. Most probably *L. latifacies* will be found eventually to occur over most of tropical South America.

(p. 306) Additional specimens examined of *Lynchia angustifrons* (van der Wulp). BRITISH HONDURAS: Gallon Jug, on 2 *Ciccaba virgata centralis* and on *Hypomorphnus urubitinga ridgwayi* (♂ fly with a mite affixed to left side of tip of abdomen) (S.M. Russell). — NICARAGUA: Musuwas, Upper Waspue River, on *Ramphastos s. sulfuratus* (B. Malkin). — COLOMBIA: La Capilla, Depto. Cauca, 6100 ft., on *Capella nobilis* (M.A. Carriker, Jr.). — BRAZIL: Nova Teutonia, State Santa Catharina, on *Glaucidium b. brasilianum* and on *Circus cinereus,* 2 ♀, both carrying Mallophaga fixed by the mandibles to the sides of the abdomen, 1 on one fly, 5 on the other; first case of phoresy of lice reported for *L. angstifrons* (F. Plaumann). — *L. angustifrons* was also taken by S.M. Russell at Gallon Jug, BRITISH HONDURAS, on *Herpetotheres cachinnans chapmani.*

(p. 308) Add to list of Neotropical hosts: Charadriiformes: *Capella nobilis* (1); Falconiformes: *Circus cinereus* (1); *Herpetotheres cachinnans chapmani* (1).

(pp. 311–312) Additional specimens examined of *Lynchia wolcotti.* BRAZIL: Nova Teutonia, Itá, State Santa Catharina, on *Buteo m. magnirostris* (2 ♀, each carrying mite clusters at tip of abdomen) and *Glaucidium b. brasilianum* (F. Plaumann). — BOLIVIA: Ipirana, South Yungas, 7 flies on *Rhinoptynx c. clamator,* and 9 flies on *Tyto alba tuidara* (Kunzel and Niethammer). — Also taken by F. Plaumann at Nova Teutonia, BRAZIL, on *Asio flammeus suinda.*

(p. 313) Add to list of known hosts, under Falconiformes: *Buteo m. magnirostris* (1). Under Strigiformes: *Glaucidium b. brasilianum* (1); *Rhinoptynx c. clamator* (1); *Tyto alba tuidara* (1); *Asio flammeus suinda* (1).

(p. 316) Delete in the bibliography the entries of *Olfersia dukei* Austen, *Lynchia dukei* J. Bequaert, and *Ornithomyia nigricans* Johnson, which all refer to the African *Lynchia dukei* Austen, now recognized as specifically distinct from the New World *Lynchia nigra.*

(p. 320) The distribution as given for Africa refers to *L. dukei* Austen, which is specifically distinct from the New World *L. nigra.*

(p. 322) The African hosts are those of *L. dukei* Austen.

(pp. 323 and 329) The African *L. dukei* Austen must be regarded as a distinct species. It differs in both sexes from the American *L. nigra* in having on the dorsum of the abdomen a median sclerite placed immediately behind the basal fused laterotergites. This sclerite is usually hidden under the hind margin of the laterotergites in dry, pinned specimens.

(pp. 332–337) Additional specimens examined of *Lynchia albipennis.* ILLINOIS: 3 miles S.W. of Hull, Pike Co., ♀ on *Botaurus lentiginosus,* April 19 (P.W. Parmalee). — CUBA: Batabano, Prov. Havana, on *Nyctanassa v. violacea* (G.E. Watson, III). — BRITISH HONDURAS: Hill Bank, on *Jabiru mycteria* (S.M. Russell). — ARGENTINA: Laguna Vaca Perdida, 50 Kilom. from Ing. Juarez, Prov. Formosa, 4 ♀ and 6 ♂ on *Tigrisoma lineatum marmoratum,* June 16 (S. Pierotti).

(p. 339) Add to list of Neotropical hosts under Ciconiiformes: *Jabiru mycteria* (1).

(p. 350) Additional specimens examined of *Lynchia hirsuta.* NEVADA: O'Neil Basin, northern Elko Co., flies on several *Centrocercus urophasianus* (G.W. Gullion). — U.S.N.M.

(p. 355) Additional specimens examined of *Lynchia holoptera.* COLOMBIA: La Candela, Dept. Huila, 11 flies (9 ♀ and 2 ♂) on *Thamnophilus unicolor grandior,* May 17, 1952 (M.A. Carriker, Jr.).

(p. 356) Add to list of known hosts under Passeriformes: *Thamnophilus unicolor grandior* (1); the heavy infestation of this bird suggests that some of the Formicariidae might be true breeding hosts of *L. holoptera.*

All the flies taken on *T. unicolor grandior* at La Candela were infested with Laboulbeniales, thus adding one more host species for these fungi. According to Dr. R.K. Benjamin, these belong to a peculiar species of *Trenomyces.*

The undescribed male of *L. holoptera* agrees in most details with the female. The relative size, shape and vestiture of the small antero-median sclerite and of the large preänal sclerite on the dorsum of the abdomen are about the same; and I see no appreciable difference in the shape of the head, the relative width of the interocular face, or other characters of the head. The terminalia are very similar to those of *L. albipennis* (Fig. 63*G*); but I can find no trace of the setigerous rudimentary gonocoxite present in *albipennis.*

(p. 370) Additional specimens examined of *Microlynchia pusilla.* TEXAS: Sonora, Sutton Co., on *Geococcyx californianus,* March 26 (O.G. Babcock). — ARIZONA: 1 mile S. of Agua Caliente Ranch, Pima Co., on *Lophortyx g. gambelii,* June 13 (C.R. Hungerford).

(p. 392) Add to references of *Pseudolynchia canariensis:* MacCreary and Catts, 1954, Univ. Delaware, Agric. Expt. Sta., Bull. **307**, p. 9 (Delaware: Newark, New Castle Co., on domestic pigeon).

(p. 394) Add to references of *Pseudolynchia maura:* Reis, 1952, Doenças das Aves, 2nd Ed., p. 218, fig. 151.

(p. 398) Additional specimen examined of *Pseudolynchia canariensis.* PUERTO RICO: Adjuntas, carrying mites (S. Silvestrini).

(p. 400) Add to paragraph on Bionomics. A ♀ of *P. canariensis* received from the Departamento de Zoologia, São Paulo, is labelled "Monte Alegre, State São Paulo on *Columbigallina t. talpacoti,* Feb. 10, 1943 (Lima Coll.)." If fully reliable, this may be the first positive record of the pigeon-fly from a native American host. At present it should only be regarded as a stray or an accidental occurrence.

(p. 413) Additional specimen examined of *Pseudolynchia brunnea.* CUBA: Las Mercedes, Cienaga de Zapata, Prov. Las Villas, on *Caprimulgus carolinensis,* Oct. 19 (G.E. Watson, III).

(p. 414, line 6 from bottom) For "(about 28° S.)," read "(about 41° S., the approximate latitude of Bariloche, on Lake Nahuel Huapu)."

Accepted, valid names in Roman; new names and main references in **bold face**; synonyms in *italics*; *animals, not Arthropoda; †plants.