A REVISION OF THE NEW WORLD SPECIES OF RICINUS (MALLOPHAGA) OCCURRING ON PASSERIFORMES (AVES)

BY

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INTRODUCTION

Species of the genus Ricinus (suborder Amblycera: Ricinidae) are the largest Mallophaga found on the avian order Passeriformes. Statements in the literature shroud Ricinus with unusual attributes. Clay (1957) stated that species of Ricinus feed exclusively on blood, whereas most bird lice are thought to feed on feathers. According to Hopkins (1942) Ricinus has an anomalous distribution occurring on approximately one-third of the seventy families of Passeriformes. Usually a genus of Mallophaga is restricted to a narrow range of hosts, a genus or a few related genera or families, or is distributed more uniformly throughout an order or orders of birds where there is a wide host distribution. Carracher (1903, 1964) has described two species of Ricinus from the same host, and several workers have recorded two species from the same host. Although this is not unique among Mallophaga, it is uncommon. Several instances are reported of a species of Ricinus found on several host species. Although lice are usually thought of as being highly host-specific, it is not uncommon for one species of lice to be distributed on several related species of host (Clay, 1949b; Keler, 1958). One species distributed on hosts in unrelated families, as in the records of Kellogg (1896a, 1898), is highly unusual. Both Kellogg (1896b) and Carracher (1903) have expressed concern over the distribution of Ricinus. Kellogg (1899) went so far as to question his ability to characterize and distinguish species.

As no revision or analysis of the distribution has appeared, I decided to revise the species of Ricinus occurring in the New World (see below) to determine the number and distribution of the species and to present keys for their identification. Since it has been postulated that Mallophaga can be used as an aid in classifying their hosts (Hopkins, 1942, 1949), the distribution of Ricinus will be analyzed to see to what extent it can be used to help settle problems of host phylogeny and classification.

Simultaneously with the commencement of this study, Dr. Goets Rheinwald in Germany started his study on the revision of Ricinus. We agreed through correspondence that he would concentrate on the species in the Old World and I would concentrate on those in the New World. Correspondence was exchanged on the status of types and other information where it was pertinent to the other's work. Rheinwald's work was published in 1968. Since our results were attained independently, I refer to Rheinwald's work only when the nomenclatural issues affect the status of New World species, and make limited comparisons regarding biology and distribution.

BIOLOGY OF RICINUS

Little is known about the biology of Ricinus. Attempts to obtain biological data have been largely unsuccessful because living specimens of Ricinus were not readily available. Limited information on the biology of Ricinus is available from the liter-
Foster (1968a) used the presence of egg cases to determine the rate of incidence of *R. picturatus* on museum study skins of *Vermimora celata*. She found 384 of 2,205 (19 percent) birds with egg cases. The rate of incidence of *Ricinus* on birds I have collected in California was less than 10 percent in groups of 20 or more birds. Although others have obtained specimens from these hosts, I have not collected *Ricinus* from *Turdus migratorius* or *Pipilo fuscus*. More than 50 specimens of each have been carefully examined. I have found only two specimens of *R. microcephalus* from more than 100 specimens of *Carpodacus mexicanus*. Figures for other hosts are similar: 3 positive out of 6 *Spizella passerina* examined; 3 positive out of 15 *Junco oreganus*; and 3 positive out of 24 *Zonotrichia atricapilla*. These data indicate that there is a contagious distribution (definition after Southwood, 1966) for various *Ricinus* spp. Baum (1968) found that the presence or absence and degree of incidence of lice, including *R. elongatus*, varied among the several local populations of *Turdus merula* that he investigated. The factor or factors that determine the observed contagious distribution of *Ricinus* spp. are not apparent.

Seasonal abundance.—Recent work has shown that there is a seasonal abundance in species of *Ricinus*. Ash (1960), who examined birds on a year-round basis, found that specimens of *Ricinus* spp. were present in almost exclusively in the months of December through March with an increase prior to the hosts' breeding season. Rheinwald (1968) found a seasonal peak in the number of specimens of *R. fringillarum* in March through May, the beginning of the breeding season of the hosts. Foster (1968b) used the presence of unhatched eggs of *R. picturatus* on museum study skins of *Vermimora celata* as an indication of seasonal occurrence. Eggs were most abundant during the breeding season of the host and least abundant following the postnuptial molt. A few eggs were found in the autumn. Foster speculated that these data indicate a correlation between the breeding cycles of the host and the host synchronized by the production of reproductive hormones of the host. Her evidence for this was circumstantial, but based on the following observations:

1. The timing of breeding in *R. picturatus* coincides with the timing of breeding in the subspecies of host. Peaks in the number of louse eggs differed by two to three weeks when the peak breeding time of two subspecies of host differed by two to three weeks.

2. No eggs were laid during the molt.

3. No eggs were found on juvenal birds, which do not produce great quantities of reproductive hormones.

4. Peak breeding in louse populations coincides with peak production of reproductive hormones.

5. Limited egg laying in late autumn may coincide with some reproductive behavior that frequently occurs at this time.

6. Philomelus sp., also found on this host, does not feed on blood and hence its life cycle shows little coordination with that of its host. Foster concluded that synchronization of the life cycles ensures a large population of lice to infest the offspring of the host.

Baum (1968) studied the life cycle of *R. elongatus* by examining dead, living, and recaptured banded specimens of *Turdus merula* for lice throughout the year over a three-year period. He found that the number of eggs and specimens of *R. elongatus*.
elongatus followed a seasonal trend corresponding to that observed by Ash, Rheinwald, and Foster. However, his interpretation of the events differed from that of Foster (1909b). Baum concluded that large density fluctuations in spring and late summer are due exclusively to the breeding and molting periods. The breeding period has a modifying character that allows the exchange of lice between paired individuals. This results in an increase in the rate of incidence and intensity of infestation. The molting period has a drastic eliminating effect on the number of eggs, nymphs, and adults. After the postmolt molt the population, which is at a low level, begins to build up at first slowly, then faster, to reach its peak again before the next postmolt molt. Baum stated that *E. elongatus* lags considerably behind other lice in its abundance values because of its large size and small microhabitat on the host. Presumably the preening efficiency of the host delays the increase in *R. cinctus*.

Further investigations are necessary to determine which of these factors are responsible for seasonal abundance: dependency upon the host's hormones or the innate capacity for increase of the lice versus the preening efficiency of the host.

Sites of oviposition.—The large and identifiable eggs of *R. cinctus* are attached to feathers in the gular area, jugulum, upper breast, sides of neck, and interscapular regions of the host. (Foster, 1909a; Baum, 1968; and personal observations). The latter two regions appear to be used only when infestation is heavy. Usually eggs are found attached singly to the underside of the rachis of feathers in the regions listed above, although Eichler (1953) and Ash (1960) reported occurrences of two to eight eggs per feather in heavy infestations. Foster (1960a) found as many as six eggs on one feather, three on either side of the shaft.

Studies have not been made on competition for oviposition sites among lice. Apparently species in different genera of lice occurring on the same host avoid competition. I have observed that species of *Philopterus* and *Mesocentrus* oviposit on the chin, gular area, and auricular feathers as well as the feathers on which *R. cinctus* oviposits. When *Philopterus* and *R. cinctus* occur on the same host, *Philopterus* eggs are not found below the gular region and *R. cinctus* eggs are not found above it. Eggs of both species are present in the narrow zone across the lower gular or upper jugular region.

It would appear from these observations that there are "preferred" oviposition sites for various genera of lice within the areas on the host were preening is relatively ineffective.

Dispersion on the host.—Species of *R. cinctus* are found on the body of their hosts, as opposed to the wings, tail, or head (Peters, 1928; Ash, 1960). Eichler (1953), Ash (1960), and Baum (1968) found specimens more often on the neck region. I found that *R. cinctus* specimens tend to wander about the body, following the apertural regions of the neck, sides, and back. Movements of lice have been reported to be slow (Pipet, 1860; Mjöberg, 1910), but it is my impression that they move faster than *mesocentrus* although slower than other ambliveners such as *Mesocentrus*. *R. cinctus* specimens appear to slide sideways between feathers when disturbed. This maneuver seems to have an advantage in avoiding the host's preening. Preferred sites for feeding, copulation, and resting are unknown.

Synoecic distribution.—The presence of more than one species of the same genus on one host species has been termed synoecia by Wentz et al. (1966). Two species of *R. cinctus* are known to occur on the same host species in the families *Tyranidae*, *Pipitidae*, and *Prunellidae*, subfamily *Euboeinae* (table 1). One of the pair of synoecic species of *R. cinctus* belongs to a species group characterized by having dimorphic mandibles, whereas the other group has monomorphic mandibles. One or both species of a synoecic pair has a polyxenous distribution, i.e., parasitizes several species of hosts (Sandground, 1929). The distribution of the synoecic species does not follow any geographical or taxonomic pattern within the range of their host. Both members of synoecic pairs of species of *R. cinctus* have been collected from common localities and once from the same bird. Dr. Clay (in litt.) verified as fact that specimens of *R. elongatus* and *R. axiastatus* were taken from a single specimen of *Hylocichla mystaceus* from Arizona in 1933 by J. Heinertzhagen. Two males, one female, and one nymph of *R. axiastatus* and one male of *R. elongatus* were collected from *Tyranus tyrannus* from North Dakota on July 19, 1929, by E. G. Bruce. The two species are mounted on separate slides and the labels do not indicate whether these specimens came from the same bird or two different birds. I have collected three male *Chipping Sparrows, Spizella passerina*, 100 meters from each other at Hopland Field Station, Mendocino County, California, on
March 23, 1965. Two of these hosts were infected with *R. subdusfus us* n. sp. and the other with *R. fringiligee*. A third species, *R. dufusus*, has been collected from *S. passerina* in Ohio and Washington, D.C. Since the occurrence of three species of the same genus on one host species is very rare in Mallophaga, I suspect the *R. dufusus* is not a contaminant. It is, however, possible that *R. dufusus* replaces *R. subdusfus us* on Chipping Sparrows in the eastern United States. *R. subdusfus us* is currently known only from hosts collected in the western states of Arizona, California, and Utah. Further collection from *S. passerina* should clarify this situation. Slides of *R. dufusus* and *R. australis* from *Passerinus sandweichensis* and *Passerina amoenus* collected in Nebraska in 1901 by M. A. Carrick, Jr., appear to have been mislabeled; *R. dufusus* does not occur on *P. amoenus*, and *australis* is not found on *P. sandweichensis*.

Blood-feeding.—Blood-feeding in Mallophaga has been noted by earlier workers: DeGeer (1778), Denby (1842), Rudolc (1879), and Nitzsch (in Giebel, 1874). However, Piaget (1890) found no evidence of blood-feeding in Mallophaga. According to Hopkins (1949) many of Piaget’s specimens were obtained from skins of birds and mammals preserved in museums. A possible explanation for his negative findings may be that the last meal of the lice was digested and eliminated. All specimens of *Ricinus* that I have obtained from museum skins have intestines devoid of any material. Ellogog (1896a) thought that lice obtained blood only from dried clots around wounds rather than from actively piercing the skin of hosts. Authors of textbooks generally have reiterated the views of Piaget and Ellogog regarding blood-feeding in Mallophaga.

Several workers have observed red blood cells in the crops of lice (Crosfield and Hinson, 1943; Hartman, 1899; Boyd, 1951; Blagoveshchensky, 1959; Nelson, 1962). Wilson (1934) observed *Menacanthus stramineus* piercing the skin at the base of chicken feathers and feeding on blood. Dubin (1847) found that *Piagetella*, which lives in the poche of pelicans, feeds on blood. He also observed the wounds made by these lice inside the poche, and demonstrated that they would pierce the human skin and feed. Kalamaz (1963) detected blood in the crops of *M. stramineus* and *Menopon gillain* by refined techniques. Employing the Technllme method which is used in criminology as a positive test for blood, he observed hemorrhagic crystals, indicating the presence of blood. Furthermore, he administered the isotope *Fe*²⁺ to the host chicken and then examined five species of lice found on the hen for radioactivity by the contact autoradiographic method. He detected radioactive blood in the crops of *M. stramineus* and *M. gillain*, but did not find radioactivity in the species of *Locustanae* which feed on feathers. Blagoveshchensky (1939) has concluded that blood is part of the regular diet of lice of the suborder Amblycera.

Clay (1957) stated that *Ricinus* feeds exclusively on blood and serum. Evidence for this statement is that red blood cells have been found in the dissected hosts repeatedly by DeGeer (1778), Mjöberg (1910), Strindberg (1917), Blagoveshchensky (1949, 1950), and Asl (1949). Feathers have never been found in the crops of *Ricinus* (Nitzsch, in Giebel, 1874; Blagoveshchensky, 1949, 1959; personal observations).

I found a nymph of a species, *Syngraphulus*, in one specimen of *R. marginatus* from *Tyto alba* (VLK 2967). This suggests that *Ricinus* may obtain food either as a predator of other ectoparasites or as a scavenger on dead animals. Rothschild and Clay (1952) reported that new skins and parts of mites and other lice have been found in the crops of lice. By far the most common substance in the guts of *Ricinus* is the red material presumed to be blood. This material was analyzed by the benzidine test which is used in criminology to detect blood. (O’Hara and Osterburg, 1962). *Nymphs of R. fringilae* from *Pipilo erythrophthalmus* were tested and gave positive results. To determine the effect of the hemocytes and auxiliary secretions of lice upon this test, specimens of *Pipilo angustalis*, an exclusive feather eater, were tested. The test for blood proved negative. Although the benzidine test is not specific for blood, it appears that *Ricinus* does not come into contact with any of the materials that would give false positives. This strongly suggests that the red substance is indeed blood. Both Clay (1949b) and Mjöberg (1910) demonstrated that species of *Ricinus* have piercing mandibles. Mjöberg described the arrangement of the pharyngeal muscles as modified for sucking. The observations of the gut contents and the anatomy of the mouthparts strongly suggest that *Ricinus* feeds on blood. Definite evidence in the form of repeated observations of *Ricinus* sp. actually feeding on blood are necessary to place this contention beyond doubt.

**Economic Importance**

In the opinion of Rothschild and Clay (1952), the fact that Mallophaga have not been convicted as effective carriers of disease is a reflection of the small amount known about their biology compared with that of sucking lice and fleas. Mallophaga are considered economically important because when they reach high population levels on domestic animals (Matthews, 1946) and poultry (Kartman, 1959), although some of the data for poultry are conflicting (Warren et al., 1948; Edgar and King, 1959; Stoedlale and Baum, 1960). Mass production of these lice is usually accomplished by determining the size of the host. However, reduction or cessation of grooming or preening by the host resulting from disease (Baum, 1968) or poor nutrition (Kartman, 1949; Utech et al., 1960) is the major factor that allows the increase of lice.

Some species of Mallophaga are vectors of helminths, and can harbor other pathogens. *Trichodectes canis* (DeGeer) has been incriminated as an intermediate host of the cestode Diphyllidium. The life cycle of *Diphyllidium* involves *Mallophaga* as an intermediate host. Both Duttin (1965) and G. S. Nelson (1962) observed the development of *Eugalia cypseli*, a parasite of African swine, in *Menopon gillain*, Nelson, and Pennington and Phelps (1969) noted the development of *Diapriota anthraconidens* in *Heterodoxus spiniger*. Nelson speculated that other cestode worms of birds and mammals may have *Mallophaga* as intermediate hosts.

The virus of eastern equine encephalomyelitis has been isolated from *Menacanthus stramineus* by Hewitt et al. (1948), and has been reported from *Menopon gillain* by Gilkey and Casals (1950). Drygaoxinae organisms have been isolated from *Menopon gillain* (Edede et al., 1962). Isolation of viruses and rickettsiae does not necessarily indicate transmission. Currently no definitive statement can be made that lice can or cannot transmit these agents. More knowledge of the biology of lice is necessary to determine if they are effective vectors or not only as mechanical or temporary receptacles for these agents.
To my knowledge Riciusus has not been investigated as a potential vector. Since members of this genus feed upon blood, Riciusus would be a prime suspect.

**HISTORY**

Clay and Hopkins (1930) stated that "No group of insects has suffered so much as at the hands of authors who were ignorant of, or careless about, the Rules of Nomenclature as have Mallophaga." Although no formal set of rules was adopted internationally until 1901, certain personal codes had been formulated, one as early as 1781 by Linnaeus (Mayr et al., 1953). However, these codes were not universally accepted. On the contrary, acceptance of authoritarian decisions prevailed even when these were contrary to the codes. Nitzsch (1818) rejected nearly all previously published names of Mallophaga and replaced them with his own names, which were adopted by most of the nineteenth-century taxonomists. Likewise Piaget (1890) rejected the work of certain authors because he considered it to be inferior. Denny's work (1842) received particularly harsh treatment from Piaget. Unfortunately, Kellogg (1908) and others accepted Piaget as the final authority on nomenclatorial matters.

Additional confusion in mallophagan systematics has often resulted from inadequate descriptions and illustrations for new species as well as from failure of authors to record a type host or in some cases any host. Many of the earlier descriptions were given in such general terms that identification of the species is now possible only because the species name was applied to a population of lice on one particular host species. In many other instances authors listed several hosts for their species and, in view of the general nature of the description provided, it is not evident that some of the species are composites. This is true of *Nemurus pteroccephalus* Offer, 1816 (now Riciusus). Although the populations of *Riciusus* from two of the three hosts listed by Offer superficially resemble each other, they are separable morphologically into two species.

Children (1836) failed to give a host for his new species, *Physostomum marginatum* (now Riciusus), and the species cannot be identified from the description. The name is available as such inasmuch as the type specimen is in existence. However, recent workers usually have been further handicapped by the lack of type specimens for the species described earlier. Except for the collections and types of Children and Denny, nearly all types of species described prior to 1880 have been lost, destroyed, or never did exist. For example, Linnaeus (1758) based many of his descriptions of lice on the published plates of Redi (1668) rather than on actual specimens.

In 1901 (published in 1905) the first International Rules of Zoological Nomenclature were adopted. These clearly indicated that some decisions of early workers and their acceptance by subsequent workers were erroneous. Therefore the Rules were received with mixed feelings by mallophagan systematists, for it was necessary to restore valid names which had not been used for approximately a hundred years and to invalidate other names that had been in use for the same period. Durrant (1906a, 1906b), Kellogg (1908), Mjöberg (1910a), and McGregor (1917) either were unaware of the Rules or ignored them, for they continued to regard Nitzsch's work and names as the basis of mallophagan taxonomy.

Neumann (1906) and Harrison (1916) initiated the restoration of mallophagan nomenclature in accordance with the Rules. The resulting debates over these and subsequent actions, especially those concerning Nitzsch's names (1818), have continued until recently (Clay and Hopkins, 1950, 1951, 1954, 1960; Hopkins and Clay, 1960). Credit is due Clay and Hopkins for bringing a degree of stability to mallophagan nomenclature. They have made decisions on the availability and validity of all specific and generic names of Mallophaga proposed from 1758 through 1818. Each decision was made in accordance with the Rules of Zoological Nomenclature. Each specific name that was not considered either *nomen nudum* or *nomen dubium* was fixed by designation of a neotype with a description, illustrations, and a designation of type host. Confusion regarding some names was so great—or would become even greater if strict adherence to the law of priority was applied—that Clay and Hopkins appealed to the International Commission of Zoological Nomenclature to use the plenary powers to validate certain names and invalidate others. In the past other workers have made decisions on some of these names, but they either neglected to or did not properly establish their contentions in accordance with the Rules. Clay and Hopkins (1960) recognized that certain of their judgments were arbitrary; however, their decisions on the name *Riciusus* and that of several species therein appear to me as well founded.

The genus *Riciusus* DeGeer has suffered from misinterpretation of the Rules in regard to its availability and validity as well as from misunderstanding its applicability. Before 1778 all species of lice (both Mallophaga and Anoplura) were included in the genus *Pediculus* Linnaeus, 1758. DeGeer (1778) determined that two different forms were included in *Pediculus*. Therefore he defined *Riciusus* to include all species now placed in the order Mallophaga and retained *Pediculus* for species now placed in Anoplura. Seven species were described by DeGeer in *Riciusus sensu lato*, of which only one, *Riciusus frigilae*, is considered now as belonging to *Riciusus sensu stricto*. No type host was given for *frigilae* from the hosts listed by DeGeer.

In 1864 Hermann, noting that the name *Riciusus* was used in botany also, proposed *Nemurus* as a *nomen nudum* for Riciusus DeGeer. Although Hermann cited no specific name in *Nemurus*, DeGeer's species automatically were included therein (Clay and Hopkins, 1964). Subsequent workers such as Offer (1816) and Leach (1817) accepted *Nemurus* Hermann in place of *Riciusus* DeGeer, and the name *Riciusus* fell into disuse from 1804 to 1906, except by Barthelmy (1836).

However, the use of *Nemurus* Hermann also was short-lived, for this name and nearly all previously published generic and specific names of Mallophaga were replaced by Nitzsch (1818). His work was accepted by most nineteenth-century workers as the basis of mallophagan nomenclature. Nitzsch, who coined the name Mallophaga, divided this group into two unnamed families which now correspond to Kellogg's (1896a) suborders, Ichneuconidae and Amblydromidae. Each family included two genera: one genus in each family contained bird-infesting lice (*Philopterus* and *Liotheus*) and the other contained mammal-infesting lice (*Trichodectes* and *Gyropus*). Within each of the bird-infesting genera Nitzsch described several subgenera, merely listing under each the included names of species and their hosts. No species were included under *Liotheus*, for no subgenus *Liotheus* existed. The subgenus *Physostomum* was included in *Liotheus* with three species. Nitzsch
indicated that one of these species, *Physostomum nitidissimum*, was equivalent to *Ricinus fringillae* DeGeer. The host was given an *Emberiza citrinella*, one of the hosts listed by DeGeer (1778). The subgenera of *Nithec* were later raised to generic status by Rudow (1870), Giebel (1874), and Piguet (1880).

Nitzsch also included *Nirimus* as a subgenus under *Philopterus*. *Nirimus Nitzsch* does not appear to be a restriction of *Nirimus Hermann*, for Nitzsch credited to a previous author each specific and generic name that he replaced or retained. However, he did not credit his subgenus *Nirimus* to any author, but listed it in a manner similar to his other proposed subgeneric names. Since none of DeGeer's (1778) species are mentioned under *Nirimus Nitzsch*, this name is considered to be a new name and not a restriction of *Nirimus Hermann*.

Following the adoption of the Rules in 1901, Neumann (1906) restored the name *Ricinus DeGeer*, 1778, based on its priority and validity. Both the 1901 and the present Rules (1961) clearly indicate that the name of an animal taxon is not to be rejected because of the use of the same name as a taxon that does not belong to the animal kingdom. Since *Nirimus Hermann*, 1804, was an unnecessary *nomen nomen* for *Ricinus DeGeer*, Neumann (1906) designated *Nirimus Hermann* as a junior objective synonym of *Ricinus*. Furthermore, Neumann designated the first species described by DeGeer, *Ricinus fringillae*, as the type species of the genus. This action restricted *Ricinus* from the *sensu lato* status of DeGeer (= Mallophaga) to *sensu stricto* status (= *Physostomum Nitzsch*), for Nitzsch (1818) had equated *Physostomum nitidissimum* with *Physostomum fringillae*. Neumann also designated *Physostomum Nitzsch* as a junior objective synonym of *Ricinus DeGeer*. Harrison (1916) gave further support for Neumann's contention by designating *Physostomum nitidissimum* as the type species of *Physostomum Nitzsch*. Clay and Hopkins (1909) agreed with the decisions of Neumann regarding *Ricinus* and its status, and further clarified the status of *Nirimus Nitzsch* (1818) had merely listed names of species in each of his subgenera, but had not described them. Thus his names have been assumed to be *nomen dubia*. However, Clay and Hopkins (1909) argued that some of Nitzsch's names are valid, for they are based upon the descriptions of previous authors and are an indication as defined by the Rules. Thus *Physostomum nitidissimum* *Nitzsch* is a *nomen nomen* and a junior objective synonym of *Ricinus fringillae*.

Neumann (1906) proposed the name *Decerebrata* as a *nomen nomen* for *Nirimus Nitzsch*, which he designated as a junior homonym of *Nirimus Hermann*. Enderlein (1909) disagreed with Neumann's action. He argued that at the time of the availability of DeGeer's work, 1804, there was a restriction of *Nirimus Hermann*, and that therefore *Ricinus* should replace *Nirimus* rather than *Physostomum Nitzsch*. There is no evidence in Nitzsch's work that this is the case, for none of DeGeer's species are listed as equivalents of species under *Nirimus Nitzsch*. Harrison (1916) and Hopkins and Clay (1925) concurred that Nitzsch's *Nirimus* is a totally different genus from *Nirimus Hermann*. Although Enderlein persisted in his contentions, they received little support, and currently no worker holds his views.

At first, authors seemed reluctant to accept *Ricinus* in place of *Physostomum*. In his checklist Kellogg (1900) used *Physostomum* and made no reference to Neumann's (1906) *Decerebrata* (1900a, 1900b), Melberg (1910), Tchida (1915), and McGregor (1917) continued to refer species to *Physostomum*. Fol-
Materials and Methods

Collection of Material.—Specimens of *Ricinus* were obtained from birds collected by myself and others, from museums, and from other sources. Collected in the spring of 1924, the term "collected" is used to denote the appearance of the species on abnormal hosts. Birds that were trapped alive were examined under a dissecting microscope for the presence of *Ricinus* and its egg cases, which are easily distinguishable from the egg cases of other Mollusca found in mammal feces (Blagojevich, 1924). Negative birds were released; positive birds were killed. A direct feather-by-feather search of some birds was made. Although this method is tedious for general collecting, it enables one to obtain for experimental work living lie that have undergone minimal disturbance, and to locate areas of house activity and oviposition sites on the host. Most birds were submerged individually and periodically shaken in liquid detergent solutions in water for 12 to 24 hours. Washings containing cataphoresates were examined directly by decanting a small portion of the solution into a petri dish and examining this directly under a dissecting microscope. As an alternate method, the solution was strained through a circle of filter paper placed in a Ricinex bucket. Cataphoresates found by these methods were removed and stored in 70 to 90 percent ethyl alcohol. I identified the majority of the birds that were collected; but when I was in doubt concerning an identification, Larry L. Wolf and George E. Chanio, Jr., of the Museum of Vertebrate Zoology, University of California, Berkeley, kindly identified the birds.

Museum study skins were not used routinely as a source of material for this study because of the probability of contamination. Hopkins (1949) input numerous erroneous host records in the work of Pignar (1889, 1885) to the fact that most of his material came from study skins. Included in these contaminants are three species of *Ricinus* described by Pignar. Hopkins repeatedly indicated that certain records of lie from mammals were contaminants when specimens were obtained from museum skins. In spite of this warning I have used specimens of *Ricinus* found by L. L. Wolf and Mercedes Foster on study skins of *Ambiophila ruficeps* and *Vermicera celea*, respectively, during their studies on these birds, because of the high probability that these specimens were not contaminants. When I examined the skins from which specimens of *Ricinus* were taken I found egg cases of *Ricinus* in each, indicating that a species of *Ricinus* was present on those birds while they were alive and was not the result of subsequent contamination. The species of *Ricinus* taken from the skins proved to be the same species that had previously been collected from the species. Although Emerson (1934) stated that records obtained from museum skins should be considered questionable, these records appear to be valid.

Preparation of material.—Two percent and five percent cold KOH and Neshit's solution were used with equal success to clear specimens. Specimens were cleared in either reagent until nearly all solid matter had dissolved. What remained was then removed by exerting gentle pressure on the abdomen.

Neshit's solution was preferred for clearing, as specimens may then be transferred directly into Hoye's mounting medium, whereas specimens cleared with KOH must be washed first in distilled water to remove all traces of KOH to prevent subsequent crystallization, and then be returned to alcohol before being mounted. Cold KOH was used, since hot or boiling KOH alters and removes pigmentation of specimens, thus destroying a diagnostic character. It is true that overfetching makes a petal pattern more evident; however, this also alters or destroys the pigmentation pattern, distorts the shape of some structures, and makes other structures difficult or impossible to see.

Staining of specimens proved to have little advantage over using properly cleared specimens. Staining usually masks the natural coloration and pigmentation pattern. Since stains are not selective, membranous and lightly sclerotized structures do not appear more conspicuous in stained than in unstained material.

Hoye's mounting medium (Balner and Wharton, 1932) was used for all unmounted material. Most specimens were mounted ventral side up on glass microscope slides. When a series of specimens was available from one host, at least one specimen was mounted dorsal side up. A few specimens were mounted between two coverslips on Cobb metal slides (Cobb, 1917), which permit both dorsal and ventral surfaces of an organism to be observed at close magnification. Because *Ricinus* specimens are large, observation at high magnification is not necessary except for a few characters on the ventral side such as mandibles, hypopharyngeal apparatus, and setae along the antennal lappets, labial, and male genitalia. Slides were dried in an oven set between 45° and 55° C. for a minimum period of ten days, and subsequently were ringed with a commercial rigging compound.
mounted in Hoyeer's mount proved to be far superior for taxonomic work than those mounted in resins, since the details of the structures are more perceptible in the former.

Examination of material.—Descriptions and types of the known species of Ricinus were examined to determine which species were valid and which occurred in the New World. Where types had been lost or destroyed or were not available to me, I have followed the precedent of Price and Beer (1963) and R. C. Nelson and Price (1965), relying on the study of specimens taken from the type host and assuming without evidence to the contrary that this material was conspecific with the original material.

The determination of the validity of the species of Ricinus is perplexing. Early authors generally used gross characters such as shape of the major body division, overall size, and coloration in their description. It is apparent in the work of Donnay (1842) that identifications may not be made with certainty from his description. Piaget (1886, 1895) used many characters in his description of Ricinus, including measurements of the various body segments, detailed accounts of the shape of various structures, descriptions of the pigmentation pattern, and some mention of chaetotaxy. Subsequent descriptions of species of Ricinus have followed the pattern set by Piaget. However, in 1899 Kellogg indicated that he was in doubt as to which characters should be used to separate species of Ricinus.

No innovations were introduced until the appearance of the works of Clay and Hopkins (1951, 1954, 1960). These authors reported that the following had specific value throughout the genus: characters of the mandibles; shape of the head; color pattern of the body; characters of the male genitalia; and characters of the terminal segments of the female abdomen. Supplementary characters of taxonomic value were given in their 1960 paper. In addition to certain of the same characters mentioned by Clay and Hopkins, Carriker (1964) listed various carinae and incisions of the head, thorax, and pleurites.

To further complicate the matter, the seventy proposed names for species of Ricinus, at least sixty were described from a single species or a small series collected from a single host. Eichler and Carriker, among others, described as new species specimens of Ricinus taken from a previously unrecorded host, since they anticipated a high degree of host specificity. Although some of these species clearly differ from known species, many show few or no morphological distinctions upon which to base their identity.

To introduce greater objectivity into the systematics of Ricinus in the present study, each series of specimens from a host species was assigned a population status. Each specimen in each population was examined as to size and shape of various structures, pigmentation pattern, and chaetotaxy. The amount of variability in these characters was determined statistically for each population. Comparisons were then made between populations to determine similarities and differences. Upon this basis was determined the validity of characters at the species level. Artifacts (differences resulting from curatorial procedures) and intrapopulational distinctions were detectable subsequently with some degree of assurance.

The following sections deal with descriptions of external anatomy, chaetotaxy, and pigmentation patterns. The description of the characters was made mostly from adult specimens mounted on microscope slides. Several adult and nymphal specimens were dissected in order to determine the topographic position and limits of certain structures, in particular the mouthparts. Each feature is described along with an indication of the amount of variability observed and the taxonomic value in Ricinus.

EXTERNAL MORPHOLOGY

Head.—The prothorax head of Ricinus is conical (pl. 2, fig. 1), subconical (pl. 18, fig. 1), or spatulate (pl. 4, fig. 1) and somewhat depressed. The shape of the head is one of the characteristic features of the genus and is useful at both the species group and specific level. Two features of the head are of particular interest, the palates and the antennae.

Palate.—The palates (pl. 2, fig. 1) are membranous lobelike extensions arising ventrally and laterally from the labrum. These structures probably have been derived from the epipharynx. They are enclosed in two fossae which are situated ventrolaterally to the labrum when it is closed. When the labrum is open the palates extend ventrally and laterally through an opening which is continuous with the fossae. Each palate is supported by two or three small sclerites which articulate with the lateral tips of the labrum. It appears that the sclerites act as hinges during the extension and retraction of the palates. Since these structures are striated as are the acetabula of trematodes, Nitzsch (1874, in Giebel) and Mjöberg (1910) postulated that they were sucking or adhesive organs.

Antenna.—The antennae are four-segmented, situated in two capsules on the ventral side of the head. The antennal lappets, the ventral coverings of the capsules, overlie the part of the second and all of the third and fourth antennal segments. The antennae appear to be quite similar throughout the genus.

Tentorium.—Symons (1952) reviewed the literature and studied the tentorium throughout the Maláphage. Within the order the tentorium occurs from well-developed to a greatly reduced form. In Ricinus the tentorium is greatly reduced. The tentorial bar consists of a ligament and is invisible in specimens mounted on slides. The anterior and posterior tentorial pits (pl. 2, fig. 1) and their connecting arms are present, but only the anterior pits are evident in certain species. The anterior tentorial pits occur ventrally in the region between the antennae and the gular plate. The frontoeypal and posterior ocipital sutures are not evident. Thus the usual value of the tentorial pits as landmarks coupled with the modification of the head made it difficult to ascertain the exact boundaries and nature of certain elements. Muscles origins appear to have shifted from the tentorium to the various epodemes or to the margins of the head. Because of these changes, some of the elements may be misinterpreted herein.

Frons.—The anteriormost portion of the head, lying anterior to the labrum, was called the "frons" by Carriker (1960, 1964). Although the term may not be equivalent to the concept of the structure in other insects (Woodgruse, 1935), I have adopted it as a useful shorthand designation for the prelabral region. The frons (pl. 16, fig. 1) is part of the clypeus. The anterior margin, which varies interspecifically, is narrowly to broadly convex or truncate, with parallel, angulate, or rounded lateral margins. Frontal carinae border the sides of the frons but usually disappear medially. Two short finger-like frontal incisations extend anteromedially for a short distance from the posteroventral corners of the frons.
A transverse carina extends across the frons but usually disappears near the apices of the frontal incisions. The transverse carina may be straight, convex, or nodally arched mediad. It is absent in species of the arcuatus and fringillae species groups. In R. arcuatus (Durrant) the transverse carina is continuous with clypeal carina. The marginal carina is a sclerotized marginal band (pl. 10, fig. 1) extending from the prescutellar region of the head anteriorly to merge insensibly with the frontal carina on the anterolateral part of the head; at the level of, or just anterior to, the maxillary carina the clypeal carina forms insensibly with the more medially situated clypeal carina.

Eyes.—Two facets are thought to be present in each eye. The eyes in the fringillae species group protrude from the head and are hemispherical in shape. In other groups the eyes are only slightly raised or reduced.

Temples.—The temples (pl. 13, fig. 1) are triangular or subtriangular in shape. The margin (postocular carinae) of the temples runs posteriorly from the eye ending in a point and re-entering medially and anteriorly as the dorsal ocipital margin and the ocipital nodal margin. The shape of the temples varies interspecifically.

Occiput.—The occiput forms the posterior margin and walls of the head. Dorsally the occipital margin is continuous with the marginal margins of the temples. The shape of the dorsal margin is concave, with the median region rounded or straight, not fused medially with occipital nodus; or concave, with the medial margins fused with the occipital nodus; or biconcave, with a medially projecting convexity. The occipital nodus (pl. 2, fig. 1) is heavily sclerotized and pigmented. The margin of the nodus is invaginated from the dorsal margin of the occiput, forming a cavity which receives the anterior margin of the prothorax. The margin of the nodus usually parallels the dorsal margin of the occiput. Laterad to the gular plate the ocipital nodus is covered by extensions of the ventral surface of the head which forms the articulations of the head with the prothorax. In the fringillae species group the medial part of this extension is shaped as a heavily sclerotized rod which forms the articulation process. In the arcuatus species group this structure is narrowly lobelike. In the other groups it is a broad, sclerotized lobe which has its origin near the level of the second antennal segment.

Nodi of the head.—The nodi of the head (pl. 16, fig. 1) are sclerotized, pigmented thickenings situated dorsally and internally. Two or three pairs are usually present. The first pair are called the lunar nodi, being quarter-moon-shaped. Lunar nodi are absent in the fringillae, brevicapitae, and arcuatus species groups. Posterior to and surrounding the anterior tentorial pits are the antennal nodi. The third pair of nodi form the dorsomedial margin of the antennal fossae and are termed antennal nodi. In a few species there are sliver-like thickenings on the dorsolateral margin of the fossae. These nodi overlie and appear to be associated with two internal apophyses which are nearly parallel to the medial margins of the nodi. These apophyses are posteriorly confluent with the posterior end of the antennal nodi and anteriorly forming cuplike depressions in which the mandibular clypeoles are situated.

Mouthparts.—The structures which surround or are associated with the oral cavity are the labrum, mandible, maxilla, hypopharynx, and labium. The labrum has already been discussed in connection with the palpi. Two structures on the labrum which have not been mentioned are the anteromedial lobe, seen only when the labrum is opened, and the two knoblike posterior extensions which form the inner point of attachment of the palpi. The mandibles are composed of the sclerotized tips, a dorsal membranous lobe which varies in shape, a medial ventral membranous lobe, and the articulations. The dorsal condyle is always present in some species, although it is nearly impossible to see without dissecting out the mandibles. Carriker (1960) stated that the dorsal condyle has been reduced in some species and are replaced by a lignumarten articulation.

Two types of mandibles are found in Ricius: a dimorphic form characteristic of the fringillae, brevicapitae, and arcuatus species groups, and a monomorphic form characteristic of the other species groups. In the dimorphic form the left mandible is thickened dorsoventrally at the base of the tip, which is abruptly pointed. Below the base of the tip is a cavity which receives the tip of the right mandible. The right mandible is not so thick dorsoventrally as the left, and the tip is acutely pointed. The left medial ventral lobe bears a finger-like process that articulates in a slight depression on the right medial ventral lobe. In the monomorphic mandibles the blades and the medial ventral lobes are similar to each other. The lobes are entire, without a finger-like process. Two species, R. iowadiens and R. mandibulatus, have mandibles with monomorphic tips, but dimorphic lobes.

The elements of the maxillae present are the stipes, the palpi, the lacnine, and the galeae. The carina is absent throughout the Mallophaga (Matsuda, 1965). The stipes forms a large maxillary plate (pl. 16, fig. 1) which bears the maxillary setae. The size and shape of the plate have diagnostic value. The maxillary palp (pl. 2, fig. 1) are four-segmented. The anterior and posterior setae of the first segment are nearly equal in length in the brevicapitae, fringillae, and arcuatus species groups; therefore the palp segments extend in a straight line. The anterior setae of the first segment in other groups is much longer than the posterior setae. The distal three segments arise from the first segment at an angle, giving the palp a gentileoid appearance. The lacmine, “maxillary forks” of Möjberg (1910) or “maxillary picks” of Ope (1941), are nearly impossible to see in most specimens, for they are lightly sclerotised and usually obscured by other structures. Their presence is indicated by the cranial lacinal apodeme. The galeae are present as membranous lobes bearing tiny tooth-like structures (pl. 34, fig. 2).

The hypopharyngeal apparatus is the most confusing element of the mouthparts. Except for Trochiloderes Paine and Mann, where a sucking function is assumed (Clay, 1949a), the function of the hypopharynx is unknown in Mallophaga (Symens, 1952). No comparative study of the whole apparatus has been made in Ricius because all or parts of this structure cannot be seen. Only distinctive differences that can be observed in all specimens are compared. Cummings (1916) has described and labeled the parts of the apparatus in Physiognomus muticus (now Ricius elongatus). A scroll-like sipaphore sclerite appears to be quite similar throughout Ricius. Only parts of the rami and anterior cornu of Cummings" figure can usually be seen. In the fringillae species group two plumose-like structures arise, probably from the tips of the anterior cornu. No such structure appears to be present in other species groups in Ricius.

The only structures that can be compared throughout Ricius are the ovoid
selerites (= hypopharyngeal lobes, superlinguae, salivary reservoirs, lingual glands), a pair of ocular structures lying medially and posteriorly to the mandibles. The size, shape, and ornamentation of these selerites have diagnostic value. In fringillae and arcuatus species groups these selerites are small, rounded, and uniformly pigmented. In R. serratus (pl. 16, fig. 2) and the subangustus species group the selerites are deeply pitted. In the diffuse species group (pl. 41, fig. 3) they are finely pitted, resulting in a fuzzy appearance. In the marginata, invaginata, and menchelatus species groups the selerites are usually not evident. They are probably membranous and unornamented and hence are not visible.

The labium (pl. 2, fig. 2) is bordered laterally by a seleritized margin. No division is apparent into palpi, glossae, or paraglossae. The figure given by Kellogg (1899) for the labium of Physornis australis (now R. marginata) is in error; the shape and the chaetotaxy of R. marginata appear nothing like the figure. In fact, the figure does not resemble the labium of any known species of Ricinus. Posterior to the labium is an inverted triangular region hereina called the mentum. A pigmented mental plate is usually evident only in the fringillae species group. The areas posterior to the mandibles and medial to the antennae are herein called the genna, although there may be some question about the homology of this area with genna in other insects.

Gular plate.—The gular plate (pl. 4, fig. 1) is an elongated triangular structure lying medially behind the mentum. The shape of the gular plate has been used by Riecker (1956) to differentiate his species. Riecker appears to have described the seleritized pattern on the gular plate rather than the plate itself. Care must be taken in differentiating these elements. The shape of the pattern has diagnostic value. Posteriorly the plate may or may not have two extensions which either point directly posteriorly or are reflected outwardly.

Postlabial.—The postlabial (pl. 3, fig. 1) is attached to the head in the manner described above. At the base of each articulation is an ameoboid cervical plate bearing two small setae. Lateral to each is a dumbbell-shaped seleritized episternal plate, which borders the coxae I. Behind the coxae is a lightly seleritized epimeron I. These two structures are connected by the thin rodlike pleurosternal apophysis. The elements of the epimeron appear to be fused together with the ventral elements. The prosternal plate is relatively uniform in Ricinus, but the shape and the amount of sclerotization of the anterior nodi have diagnostic features.

The shape of the prothorax is an excellent diagnostic character (Carriker, 1964). The only general statements that can be made are the following: the anterior margin is biconvex, with a medial concavity, and the ventral plate in the closed related populations the shape is similar or varies slightly. This structure has value both as a character for separation of species and for determining relationships of species groups.

Pterothorax.—The fused meso-metathorax and first abdominal segment comprise the pterothorax (pl. 3, fig. 1) in Ricinus (Cope, 1941; Clay and Hopkins, 1960). This bell-shaped structure is quite uniform in Ricinus. There appears to be a loss or fusion of the dorsal nodal plates. The anterior "shoulders" are pigmented and consist of the fused episterna I and pleural paragrama II. Episterna II appear to be fused with the episterna III and part of the pleural paragrama III. Episterna III appear to be fused with the ventral pleurites of the abdominal segments I and
trochanter arises from the coxa at right angles. The shape of coxae I appears to be uniform throughout Ricinus, but the size of trochanter I varies between species groups. Femora I and tibiae I are nearly equal in length. The second and third pairs of legs are similar in shape; the third pair is slightly larger. Femora are short and thick in fringillae and arcuatus species groups but narrow and elongated in other groups. The tarsi are two-segmented.

**Male genitalia.**—The external male genitalia appear to be fairly uniform and simple throughout the genus. Clay (1956) has stated that the structures of the male genitalia "may be fuse, in such a way as to make their homologies obscure and it is not always possible to homologize the parts even between species belonging to the same genus." The terminology of Błagojewichensky (1964) is used here for these structures. The basal plate, or basal apodeme, extends anteriorly into the abdomen. Its shape varies greatly within a population; so caution must be exercised in using this character taxonomically. Two processes articulate with the postero-lateral corners of the basal plate. The shape of the processes has taxonomic value; they may be elongated, short and triangular with acute or obtuse apices, or broadly rounded. The mesosome is a ringlike structure that articulates with the postero-lateral corners of the basal plate. The posterior margin of the mesosome may be entire (pl. 19, fig. 6), weakly or strongly pointed (pl. 18, fig. 4), or expanded into a large plate (pl. 5, fig. 2). The prepubial sac, or genital sac, is in the space surrounded by the basal plate and the mesosome and is lightly sclerotized.

The prepubial sac appears to have a certain diagnostic value. Its shape in the arcuatus species group resembles a bouquet of cut flowers or the hemipenis of snakes (pl. 5, figs. 2, 4). The sac in the fringillae group resembles a flower with petal-like lobes surrounding the stoma (pl. 9, fig. 7). The sac in R. marginatus is extremely amorphous (pl. 19, fig. 4). In other species there is little variation in shape (pl. 19, fig. 6). Several pairs of campanuliform sensilla are present on the prepubial sac. The prepubial sac, mesosome, and parameres are exerted during copulation (pl. 9, fig. 6).

**Sexual dimorphism.**—Sexual dimorphism is usually limited to differences in size, to the characters of the terminal segments in each sex, and to the presence of the external genitalia in males. Males are usually somewhat smaller than females. Sexual dimorphism in the shape of the prosternal plate is limited to the males of some members of the fringillae species group in which the lateral prosternal nodi are turned inwardly and medially (pl. 9, fig. 8).

**Nymphs.**—A few nymphs were available for study. Either they are rarely collected or are ignored by collectors. Only once did I have an opportunity to observe males, females, and all three nymphal instars of a species, R. arcuatus (Kellogg and Mann). The chaetotaxy in all three nymphal instars of this species is similar to that of either the adult male or the adult female. The nymphs differ from each other in size and somewhat in the degree of sclerotization and pigmentation. They also differ from the adults in smaller size, in shape, in lesser degree of sclerotization and pigmentation, and in the absence of genital sclerites. Study of nymphs associated with adults is invaluable, for each species and structure are better observed in nymphs than in heavily sclerotized adults for study.

**Eggs.**—The eggs of Pectinae are easily distinguished from those of other Mallophaga. They have been figured and described by Mööberg (1910), Lochler (1953), Błagojewichensky (1959), and Foster (1968a). The shiny yellow eggs are larger than the eggs of other Mallophaga found on passerines. The margin of the operculum is entire with the margin of the rest of the egg. The operculum and adjacent regions bear a pattern of interconnected polygonal indentations.

**CHARTOTAXY.**

According to Badovski (1967), writing with reference to Acaena, chartotaxy permits the use of patterns of setal distribution and differences in individual setae in description, classification, and phylogenetic interpretation. Several systems of chartotaxy have been proposed by zoologists, but to my knowledge no such system has been erected for Mallophaga. Clay (1947) and Clay and Hopkins (1960) have made a start in this direction. I have adopted their terminology whenever it was practical. Letter designations are given to some contiguous groups of setae. Numbers following the letter designation indicate the number of that setae or setal pair in the letter group. Certain setae, e.g., labialmentits, anterior labrals, or postspinecules, are designated by name rather than by letter. Each group of setae that is assigned a letter or name is believed to be homologous, as its location is consistent throughout the genus Ricinus. Stability and variation in these setae are particularly significant in demonstrating diagnostic features and relationships in Ricinus.

There is considerable asymmetry in certain setal groups such as those on the gular plate and along the margins of the antennal lappets. Therefore, the number of setae on each side in indicated as X X. The usefulness of certain setal patterns is indicated where appropriate. Where no comments are made, it should be assumed that these setae are constant throughout the genus.

**THE HEAD.**

**The cf series.**—The cf series is composed of short setae that border the circumferential margin of the frons. In the fringillae and arcuatus species groups there are 13 setae; in the remaining species there are only 10. These setae are not illustrated.

**The df series.**—The df setae (pl. 2, fig. 1) are a pair of short setae situated submarginally on the dorsum of the frons. Since this pair is not found in the fringillae and arcuatus species groups, it is assumed that it is incorporated into the cf series, which occupies a position just anterior to where df would be present.

**The d series.**—The d series (pl. 2, fig. 1) is composed of three pairs of short setae located ventrally on the frons. Pair 1 is located submarginally and is longer than f2 in some species, as in R. marginatus. Pair f2 is on or near the tip of the frontal incisura.

**The a series.**—The a series (pl. 2, fig. 1) is composed of three pairs of short setae on the dorsum of the head. They are consistent in size and relative position throughout the genus.

**The a series.**—The a series (pl. 2, fig. 1) consists of, at most, six pairs of setae on the dorsum of the head in the region of the temples. The letter designations is an expansion of the terminology of Clay and Hopkins (1960). The pair designated as a1 has one or two pairs of sensilla associated with it. Setae a2 to a6 are always short and pilose. The arcuatus and
breviscapitis species groups have the full complement of six pairs. Setae a₄ are absent in the fringillae species group and setae a₃ are absent in all other species groups. The presence or absence of pair a₆ follows no taxonomic pattern, but it is usually absent in the smaller species of a group.

The t series.—The t series (pl. 2, fig. 1) consists of three pairs of long and whip-like setae situated dorsocentrally on the temples. Setae t₁ and t₂ are equal in length; t₃ varies from approximately half the size of t₁ to t₂ of the same size.

The m series.—The m series (pl. 2, fig. 1) consists of four pairs of setae located dorsocentrally on the marginal carinae between the junction of these carinae with the elyptic carinae and the eyes. The anterior three pairs (m₁–m₃) are short and equal in size, except in the fringillae species group, where they are subequal, increasing in size from m₁ to m₃. Seta m₂ varies in position with relation to m₁ and usually is posteriad and submedian to m₁. In some species m₂ is laterad or posteriad to m₁ and is off the marginal carinae. Seta m₄, which has a certain diagnostic value, varies in length from equal to the length of m₁ to approximately the length of t₃. Seta m₄ is subequal to the length of m₃ and m₄.

Labra.—Two rows of setae, the anterior and the posterior labra (pl. 4, fig. 1), occur on the sclerotized labrum. The anterior labra always consist of four setae; the outer pair are three or four times as long as the inner pair. The posterior labra consist of 29 setae. The inner six setae are short setae, nearly equal in length. They are equally spaced except for the innermost pair, which are separated from the others by a short distance. Outer pairs 1 and 3 are longer than the outer pair of anterior labra. Pairs 2 and 4 are two to four times as long as the short inner setae but shorter than pairs 1 and 3.

Lateral setae.—The pattern and number of setae on the labium appear to be diagnostic for Rricinus species (Clay and Hopkins, 1960). Figures of the labium and its setal pattern are given for each species.

Labial setae.—The labial setae are a pair of tiny setae at the junction of the labium and mentum (pl. 2, fig. 2).

Mental setae.—The mental setae (pl. 2, fig. 1) are a pair of medium to moderately long setae that occur laterally to each other on the mentum, except in R. serratus (Durrant), where they may be positioned anteroposteriorly. The length of this pair is subequal to the maxillary setae.

Maxillary setae.—The maxillary setae (pl. 2, fig. 1) are a pair of medium-sized setae on or near the medial margin of the maxillary plate.

Paramaxillary setae (pm).—The paramaxillary setae are a pair of short setae situated laterad near the posterior end of the maxillary plate (pl. 2, fig. 1).

Gular setae.—The gular plate (pl. 4, fig. 1) bears several pairs of setae bearing its midlateral margins. Usually the posterior pairs are longer than the anterior pairs. Considerable intraspecific variation and asymmetry in pairing occur, although there is a basic number or pattern for some species. In R. picturatus (Carriler) the basic number is two pairs, but three pairs or the presence of unpaired setae such as a 1x2 or 1x3, or 2x3 are not uncommon. In R. tessulata (Kohl) there are three pairs of setae, with the middle pair longer than the anterior and posterior pairs. In fringillae and arcuatus species groups the number of pairs vary from three to nine, with much asymmetry. There is an extreme size difference between the anteriormost and the posteriormost pairs. These three examples show that the presence of an additional pair of setae on the gular plate is not a good character for differentiating species.

The para-antennal setae (pa).—The pa series (pl. 2, fig. 1) consists of two pairs of ventral setae situated laterad to the proximal antennal segments. The pairs are usually similar in size. The para-antennals vary over the same range in size as m₄ and are compared to m₄.

The preantennal setae.—The preantennals are a pair of setae (pl. 2, fig. 1) located anteriad to each antenna. The inner seta is larger than the outer. In most species these setae are strongly spinose, but in some species in the arcuatus species group they are pilose.

The setae of the antennal lappets.—These setae constitute a series of small to medium size bordering the lateral margins of the antennal lappets (pl. 18, fig. 1). The number of setae, which ranges from two to 35 pairs among the species of Rricinus, usually varies considerably within a specimen, population, or species. Even so, certain species have a characteristic number or pattern. In some species these setae form a continuous series with the postocular setae; in other species there is a discontinuity between the two groups of setae.

The postocular setae.—The postocular series (pl. 4, fig. 1) consists of three or more setae on the lateral edges of the carinae posterior to each eye. The first postocular is usually a medium-sized spinose seta. Setae p₁ and p₂ are pilose, varying from the same size as p₁ to ten times that size. Seta p₃ is a thin pilose seta equal to or shorter than p₁. When four setae are present in the series, p₂ and p₃ are nearly equal and p₁ is short and pilose.

Maxillary palpi setae.—The maxillary palpi are four-segmented. In most species it is impossible to determine the exact number of setae per segment because of the orientation of the segments and the difficulty in determining whether a seta is absent in fact or because of breakage. The distal segment bears approximately 14 to 20 setae terminally. Segment 2 appears to bear three setae throughout Rricinus, and segments 1 and 2 bear four setae. The proximal segment in some species, as in R. mandibulatus, has a strongly spinose seta or is bordered with microtrichiae. These setae are not illustrated.

Setae on the antennal segments.—There are two short setae on each of the first two segments of the antennae. No setae occur on the two distal segments.

The Prothorax

Prosternal plate setae.—There is one pair of short setae (pl. 3, fig. 1) on the anterior margin of the prosternal plate. The distance between these setae has diagnostic value in some species groups.

Dorsal prothoracic setae (p).—Two pairs of short setae are positioned dorsally on the prothorax (pl. 3, fig. 1) throughout Rricinus.

Cervical setae.—Two short setae occur on each cervical plate throughout Rricinus (pl. 2, fig. 1).

Lateral prothoracic setae (l series).—The l series (pl. 3, fig. 1) consists of pairs of setae situated laterally or sublaterally along the margin of the prothorax (pl. 3, fig. 1). Setae L₁ and L₂ are always pilose. In heavily sclerotized species L₃ is difficult to see, but it is absent only in R. australis and R. mandibulatus. Setae L₅ are usually longer than L₄ and L₆ except in the arcuatus complex and in the species...
R. invadens (Kellogg), where they are equal in length. L6 may be absent in some species, and in other species several setae are present between L5 and L7. These are called, for convenience, S6 through S8, depending on the number present. Setae L7 and L8 are always long (equal in length to t1 and t2). Setae L9 is as long as L7 and L8 in some species, medium-sized in others, and short in most.

**Pterygostomum**

The c series.—The c series (pl. 3, fig. 1) consists of four pairs of setae situated dorsally on the pterygostomum. Setae c1 are spinose and often longer than c2, which are either spinose or pilose. Setae c3 and c4 are pilose and vary in size even within a species. In the arcuatus complex only one of the two posterior pairs is present. Setae c4 are assumed to be absent and c3 present. The two latter pairs appear to have more diagnostic value than the two anterior pairs.

The w series.—The w series (pl. 3, fig. 1) consists of spinose setae located submarginal ventrally and dorsally along the anterior half of the pterygostomum. The series varies in number from five to ten setae. The postero-marginal pair or two pairs of setae, which are separated from the rest of the series, are usually smaller than the anterior pairs. The anteriormost setae are similar in size in fringillae and arcuatus complexes, but vary in other species groups. The number of setae tends to vary by no more than one or two setae within a species, but asymmetry is fairly common.

The q series.—The q series (pl. 16, fig. 4) is situated ventrally and submarginally. Setae q1 are located apically on the shoulder of the pterygostomum and pilose in most species. Posterior to the last w pair is one pair of strongly spinose setae (q2). In most species, two pairs of short spinose setae (q2 and q3) in a few species, and three pairs of strongly spinose setae (q2–q4) in R. serratus (Durrant). Setae q5 are at the lateral terminal corner of the pterygostomum when they are present.

The b series.—The b series (pl. 3, fig. 1) is situated dorsally on the posterior margin of the pterygostomum. Setae are called "b" by Clay and Hopkins (1960), who pointed out the interspecific variation in size of the outer pair, b1. Setae b1 are small in most species to nearly equal to setae b2 in the fringillae species group.

The parasomal setae.—The parasomal pair of setae are at the lateral margin of the sternal plate about one-fourth the distance from its anterior margin. This pair is spinose and has its origin on the body, not on the sternal plate.

The sternal setae.—The short lateral setae of the sternal plate are represented by one or two pairs. The second pair is sometimes offset the plate. The main centrally positioned setae, here called the sternal setae (pl. 3, fig. 1) vary in number and length. In most species one, two, or three pairs of moderately long to long setae are present. The posterior pair are short to medium-sized setae.

**The Abdomen**

The first abdominal segment is fused with the metathorax. The abdominal segments are given in Roman numerals and are numbered I (= apparent I) through IX (= apparent VIII).

Postspiracular setae.—Each of the postspiracular setae (pl. 3, fig. 3), which are similar throughout the Mallophaga, arises from an alvalus. Two tiny setae are associated with each postspiracular seta. Clay (1954) stated that these setae are usually on the tergites near the spiracles. In Ricinus the postspiracular setae are on the dorsal halves of the pleurae, somewhat removed from the spiracles. The spiracles and their associated sensilla are on the tergites of segments III through VIII. No spiracles occur on segment II, even though sensilla and postspiracular setae are present. Associated with each postspiracular seta is a short pilose seta anterolateral to it.

Ventropleural setae.—Three setae (pl. 3, fig. 3) occur on each posteroventral margin of each of the abdominal segments II through VIII. Their size and shape, especially those of segments II through V, are diagnostic at the species level.

Tergal setae.—There are two pairs of tergal setae (pl. 5, fig. 1) of variable size on the posteroventral margins of the tergites. Usually each of the two pairs are adjacent to the others. The tergal setae are reduced to one pair on segment VIII in R. marginatus.

Setae on sternites.—Two pairs of setae (pl. 3, fig. 3) occur on sternites II through VIII in both sexes. The sternolaterals (the outer pair) and the sternocentrals (the inner pair) are equal in segments II through VI, whereas the sternolaterals of segment VII are much longer than the sternocentrals. In males only sternolaterals are present on sternites VIII and IX. In females the sternolaterals on sternite VIII are as long as those on VII. The sternocentrals on sternite VIII are absent in females and are replaced by thin pilose setae called the valval setae.

These setae show both intra- and interspecific variations in number, but each species appears to have a characteristic number or pattern.

Terminal setae of segment IX.—The terminal setae of segment IX (pl. 3, fig. 3) are arranged laterally on each side of the anus. The pattern of these setae, although subject to minor variation, has diagnostic value.

Anal fringe setae.—The anal fringe setae border the anus. In males, setae on both anterior and posterior fringes are short, sparse, and equal in length. In females of the fringillae species group the posterior fringe is similar to that of the male, whereas the anterior fringe is a double row of short setae of equal size. R. arcuatus is similar in R. fringillae except that the posterior fringe bears more setae in the female than in the male. The remaining species have two rows of tightly spaced setae that vary considerably in length.

Male genitalia setae.—Setae, from one to five on each tip, are found on the posterior tips of the parameres. Setae are present also along the margins of the parameres in R. leptosomus and R. myriacanth. No setae are found on the parameres of the fringillae species group.

**The Legs**

In general, chaetotaxy of the legs appears to be quite uniform throughout the genus. Interspecific variation does occur in the number of long setae (termed "tactile" herein for convenience) on some segments, and in the number of spinose setae on the distal end of each tibia, termed "crown" setae.

Setae of the prothoracic legs.—The pattern and number of setae on the coxae are remarkably constant. Interspecific variation occurs in the degree of spinosity exhibited in the three setae along the margin between the coxa and trochanter. Usually there are two long tactile setae posterior to each coxa, but R. serratus and R. sittae have one seta. A spinose seta is present on the trochanter in some
species. The femur usually bears two tactile setae, but in some species a third seta is present. Five tactile setae are present on the tibia. The crown setae of the tibia include two or three spinose setae.

Setae of the pterothoracic legs.—The second and third pair of legs are similar in length, but the third pair is longer. The patterns of setae are quite uniform except for the presence or absence of tactile setae and variation in the number of crown setae on the tibia. In some species the same number of tactile setae occurs on the coxa, trochanter, and femur of leg II and leg III. In most species one tactile seta is present on coxa II and one tactile seta on femur III. The number of spinose crown setae varies from two to five, with five the most common.

Tarsal setae.—The tarsi are usually not oriented properly to determine the number of setae on each segment. However, it appears that two pairs of setae occur on the first tarsal segment and three pairs on the second.

MEASUREMENTS

Measurements were made with the aid of an ocular micrometer and are expressed in millimeters unless otherwise indicated.

Total length.—The total length is the distance along the midline of a specimen from the tip of the frons to the end of the posterior anal lappet, exclusive of setae.

Greatest width.—The greatest width is measured along the suture dividing the abdominal tergites IV and V (apparent tergites III and IV). The width of the abdomen is particularly subject to alteration by curatorial procedures. Usually the abdomen is shriveled as a result of dehydration or improper penetration of the mountant, rather than swollen.

Head length.—Head length is measured along the midline of the head from the tip of the frons to the dorsoposterior margin of the ocellus. Care must be taken in distinguishing the ocellular margin from the posterior margin of the prothorax or prosternal plate.

Head width.—The greatest width of the head is measured at the level of the eyes or slightly posterior to the eyes where the eyes have been reduced. The width of the head appears to be easily altered. Shrinking is recognized by wrinkles along the marginal curvatures and displacement of setae along the margins. Overexposed specimens are particularly subject to either shrinking or swelling.

Head index.—The head index is the ratio between head width and head length. It is determined by the following formula:

\[ \text{Head index} = \frac{\text{Head width}}{\text{Head length}} \times 100 = \text{III} \]

This ratio has descriptive but not diagnostic value in Ricasus.

Larval width.—The larva is measured from tip to tip. The width does not differ whether the larva is open or closed. Clearing and mounting procedures do not alter the width of the larva.

Prothoracic length.—The length of the prothorax is measured along the midline of the dorsal surface of the prothorax. This measurement is rarely subject to alteration by curatorial procedures.

Male genitalia.—Several measurements were made on the male genitalia. How-
as those seen among large series mounted in a single mountant. Specimens that were received in a dehydrated condition and later relaxed in trisodium phosphate fell within the normal range of variation of a population. Overcolored specimens are distorted and are larger or smaller than properly cleared specimens.

As with measurements and chaetotaxy, there is some intrapopulational variation in shape, but it is slight. Any extreme differences usually result from obvious injury to the specimen, orientation of the specimen on the slide, or subtle shriveling of fragile characters. Certain differences in the shape of structures result from euratorial processes. Ricinus spadix, R. exul, R. orbifrons, and R. subterraneus, all described as new species by Carriere (1964), were described from distorted specimens and are synonyms of other species. Subtle changes are not easily recognized.

Some intrapopulational differences in head shape may be explained by the orientation of the mounted specimen on the slide. The head may be tilted away from the horizontal position, and the pressure of the coverslip may alter both the shape of the frons and the occipital region. This orientation seems to account for the slight differences in several specimens referred herein to *R. diffusus* in which these specimens differ from typical *diffusus* only in the shape of the frons and the occipital margin.

Slight changes occur also in the shape of the mandibles, a character that has specific value. Populations of *Ricinus australis* initially appeared to have mandibles which vary greatly in shape. However, examination of the tips under high magnification shows shriveling in the proximal part of the tips, an area that is lightly sclerotized. The degree of shriveling accounts for the apparent difference in the shape of the mandibles. Three specimens taken from the same host, *Opororina* tomenti, referred to *Ricinus emersonii*, n. sp., all have differently shaped mandibles. In each instance the mandibles are oriented slightly at an angle from the horizontal. The type specimen of *R. subangulatus* also appears to have mandibles with longer tips than in other specimens referred to this species. In this case the tips project outward into the oral cavity. Since the taxonomic value of the mandible is great, it is important to determine whether differences are real or the result of artifacts.

**PIGMENTATION**

The pigmentation pattern has been used in species descriptions of *Ricinus* by most authors. Kellogg (1896a, 1899), Carriere (1902, 1903, 1904), and Durant (1906, 1909) placed much emphasis on this character. Furthermore, Clay and Hopkins (1951, 1960) concluded that the pigmentation pattern has diagnostic value in *Ricinus*. Most species have a characteristic pattern or color, although a few species share a common pattern. Certain species can be easily identified solely by the pigmentation pattern, as in *R. australis*. A difference in pigmentation pattern unaccompanied by other distinguishing characters is rare; however, there are such differences have been observed in this study. The population of *Ricinus* on *Parus* spp. has been referred to *R. medius* Uhkida. This population differs from *R. fringillarum* in only two characters: darker-colored carinate of the head and a darker sternite pattern. The lack of other differentiating characters has led Reinwald (1965) and me to designate *R. medius* as a junior subjective synonym of *R. fringillarum*. Specimens from *Dendroica petechia* from Florida and Cuba differ from specimens from the same host from Minnesota and New York in the coloration of the pleurites. In the latter specimens the pleurites are pigmented to the margin; in the former they are not pigmented. All species are referred to *R. dentrolocnium* n. sp. More collections must be made throughout the range of this host to clarify the status of these populations.

The basic color of the nodi, carinæ, and plates has diagnostic value. The colors are black, brown, red-brown, gold, and oxblood. The intensity of these colors is often so modified by euratorial procedures that it is useless to describe the color other than in general terms. The background color of species, defined herein as the areas other than the nodi, carinæ, and plates, has some importance. Usually the background is white, but in heavily pigmented species, such as *R. brevicapitis*, *R. carlsonii*, and *R. complicatus*, it is brown.

The nodæ of the head, prothorax, prosternal plate, thorax, and pleuræ as well as the epimera and phragmata of the thorax are pigmented in each species. The labrum and gular plate are nearly always pigmented. The patterns that have diagnostic value are those on the gular, mental, and sternal plates, and the markings on the female sternites. The tergites are rarely colored except in *R. japonicus*, *R. sciurii*, and the heavily pigmented species listed above. The pleurites may be pigmented to their outer margins in *R. pictus* or not pigmented as in *R. patellus*. This variation occurs fairly regularly in pairs of closely related species. The carinae of the head and legs are usually not much darker than the background, but are heavily pigmented in *R. australis*, *R. complicatus*, and *R. arceatus* among others. Occasionally the mesonotum of the male genitalia is colored, as in *R. sciurii* and *R. thoracicus*.

Since the pigmentation pattern is altered by staining, it is recommended that specimens of *Ricinus* should not be stained.

**SPECIES CONCEPT**

Species are defined as groups of actually or potentially interbreeding natural populations, which are reproductively isolated from other such groups (Mayr, 1942). Populations rather than individuals are considered to be the basic taxonomic units. Thus all the available biological data, especially regarding reproduction, are considered along with morphological data. In the absence of data from breeding experiments between populations, potential capabilities for interbreeding must be inferred indirectly from other information. Morphological differences between sympatric populations usually supply ample evidence of reproductive isolation. The investigator must judge whether allopatric populations can interbreed. Inference must be based on analysis of the morphological differences between these populations (Mayr, 1942). Since few biological data are available for Mallophaga, the potential capacity for interbreeding between populations must be inferred from morphological data and host distribution data.

Some workers believe that the best inference comes from the examination of host distribution data. Zlotorycka (1964) stated that "... the Mallophaga display strict host specificity because their hosts especially various species of birds are essentially isolated from one another. Hence almost every bird species harbours different lice species (narrow specificity considered). Thus the detection of a parasite species so far unknown for this particular bird is an important hint for describing it as a new one." Eichler (1966) remarked, "Even if we have not yet
proven that morphological differences exist between 'populations' of lice of different hosts, we may assume that such a 'population' is 'reproductively isolated from other such populations (on other host species) to the extent that future evolution is likely to lead to further divergence from its relatives.' Eichler also assumed that morphologically indistinguishable populations found on separate host species were sibling species.

The contents of Eichler and Zlotoryzka are rejected for the following reasons:

1. Their hypothesis is based upon a priori assumptions that anticipate evolution and speciation rather than upon data that document the course of evolution and speciation in Mallophaga. Eichler’s assumption that morphologically indistinguishable populations are sibling species is not supported by Mayr et al. (1959), who concluded that geographical data are not decisive in detecting sibling species. Such species are discovered in taxonomically well-known groups by refined methods (cytogenetical, biometrical, or taxonomic-ecological), none of which has been applied to Mallophaga.

2. Their hypothesis assumes a common mode of evolution for the Mallophaga which precludes the presence of extremely plastic or conservative groups within the live, a situation found commonly in other groups of organisms (Worthington, 1940; Rensch, 1959).

3. Their hypothesis assumes that isolation of lice on different hosts is sufficient evidence to indicate that speciation has occurred. This idea is not in harmony with concepts of the majority of evolutionists. Blair (1943) outlined the following steps for speciation. Speciation occurs as the result of: (a) isolation of one or more parts of a previously interbreeding population; (b) morphological differentiation as a result of differential mutation and selection pressure; and (c) the development of mutual infertility through germline or chromosomal changes. Blair concluded that, since evolution is a dynamic process, speciation may be reversed as long as the third step has not occurred. Although it is generally agreed that speciation occurs in isolation (Mayr, 1963), isolation only supplies opportunity for it to occur. Since infertility between populations of Mallophaga has not yet been tested, speciation must be inferred from the degree of morphological differentiation. This contention is supported by Simpson (1961), who stated that morphological differentiation usually reflects genetical differentiation. He further stated, “If no appreciable genetical differences have developed among them, it would be unreasonable or almost ridiculous to insist that each different population is a separate genetical species, even if no interbreeding has occurred.”

4. Their hypothesis leads to the conclusion that the classification of Mallophaga is based more on the classification of the host than upon its own merits. According to their hypothesis the inclusion of two previously recognized host species as conspecific or the division of one species into two or more separate species would automatically synonymize or erect species of lice.

5. Their hypothesis assumes that different host species are isolated from each other. This assumption is in accordance with the views of most workers in Mallophaga, such as Kellogg (1906a, 1915) and Hopkins (1942, 1945). However, I agree with Dubinin (1957), Vandzolin and Guimarães (1955), Mayr (1957), and Keler (1958) that host species are not isolated as the above-mentioned authors indicate. In fact, the mammalian and ornithological literature indicates that the frequency of interspecific contacts is far from rare. Thus the opportunities for interspecific transfer of lice are greater than has been previously recognized. Interspecific transfer of lice may ensue from the occurrence of mixed-species flocks from the use of common dust baths, roosting sites, burrows, or nesting sites, through the activities of “helpers,” and during hybridization.

Mix-species flocks include individuals of several different species, numbering from two to more than a dozen in extreme cases (Moyñihan, 1962). Some mixed flocks are essentially transitory; others are semi-permanent, very long-sustained, or dissolved and re-formed at more or less regular intervals. Certain of these flocks are tightly integrated and have a complicated social structure. Moyñihan stated that mixed-species flocks are found everywhere, but appear to be more common and in certain regions of the tropics. Most of these flocks are largely or completely composed of passerines, including both permanent residents and a few migrant birds. These flocks afford ample opportunity for interspecific contacts of birds, and hence interspecific transfer of lice. Several of the most common host species forming mixed-species flocks are known hosts of species of Ricinus.

The use of common dust baths, common roosting sites, and approximate nesting sites presents opportunities for interspecific transfer of lice through direct contacts of the birds or through the agility of the lice themselves. Hoye (1958) has demonstrated both experimental and natural transfer of two species of lice from chickens to Passer domesticus through the use of common dust baths. Kellogg (1958) and Huculik (1947) found Mallophaga typical of water birds occurring on land birds. They speculated that transfer had occurred because these birds frequently perch close together. Hoye (1948) and Houck and Oliver (1954) reported nesting of different species of birds within 5, 10, 15, and 18 inches of each other. Lice could easily travel those short distances.

Direct interspecific contacts occur between birds where one bird acts as a “helper” (Skutch, 1961), “a bird which assists in the nesting of an individual other than its mate, or feeds or otherwise attends a bird of whatever age which is neither its mate nor its dependent offspring.” Several species that serve as hosts for species of Ricinus are reported as helpers by Skutch.

Hybridization also indicates evidence of direct contact between different host species. It many be argued that the hybrid would represent a dead end for the transfer of lice, since the hybrid is usually infertile. However, subsequent contacts made by the parents and the hybrid offspring may perpetuate secondary infections. Furthermore, abortive attempts at mating between different species probably occur at a greater frequency than the observed successes. Kellogg (1958) speculated that the frequency of hybridization among ducks accounted for the distribution of the same two species of lice common to many duck species. Cockram (1952) has listed the cases of hybridization of North American birds. Known hosts for Ricinus spp., which frequently hybridize are found in the Fringillidae (between Passerina spp., Junco spp., and Junco and Zoothera) and Parulidae (between Vermivora spp. and Dendroica spp.). Silbey (1957) reported an occurrence of hybridization between Pipra erythrocephala and Manacus manacus. Both of these hosts harbor the same two species of Ricinus. Short and Simon (1965) listed nine records of hybrids between Junco hyemalis and Zoothera dauma.
The same two species of *Ricinus* are found on these hosts. Dickerman (1961) discovered a hybrid between *Meloporia melodia* and *Zonotrichia leucophrys*, both of which harbor the same two species of *Ricinus*. Other records are available, but these are sufficient to indicate that interspecific contacts through hybridization do occur.

Secondary infestations apparently have resulted, but few have been documented. Boyd (1951) reported that *Desmocerca nebulo* (now in *Brucella*) has transferred from *Sturnus vulgaris* to *Turdus migratorius* since the introduction of the former species into the New World. In turn, a species from the New World family Icteraeidae, *D. illustris* (now *Brucella ornata*), has transferred to *S. vulgaris*. In mammals the dog has acquired a species of *Heterodoxa* from marsupials, and *Sphingulus brasiliensis* has acquired three species of *Mallophaga* from caviar (Hopkins, 1949; Vasconcelos and Guimaraes, 1955). Clay (1949a, 1957, 1962) has drawn attention to the possibilities of secondary infestations and cited several cases. The presence of two species of *Ricinus* on one host species appears to indicate secondary infestation by one of the species.

These observations indicate that different host species are not isolated and that contacts are frequent enough to account for the establishment of secondary infestations. It is probable that most interspecific transfers of lice fail to become established because another species of louse is already present in that niche. However, where the niche is open, establishment is likely. Since the infestation rate for species of *Ricinus* is low, it is not inconceivable that the same species could become established on different hosts through interspecific transfer. It is also probable that interspecific transfer provides sufficient gene flow between various populations of polygenic species of *Ricinus* to prevent genetic drift and subsequent speciation.

The majority of taxonomists agree that, in the absence of direct reproductive data, the degree of morphological differentiation is the best indication of the potential capacity for interbreeding between allopatric populations. Simpson (1961) has recommended the use of multiple characters at each level of classification. Nelson and Price (1965), referring to *Mallophaga*, stated that taxonomic procedure should be based on current knowledge, and that it must always be recognized that structural and biological evidence may subsequently be found for further separation. This philosophy has been followed herein.

The following situations were observed in the course of this study on the populations of *Ricinus*: (1) populations that differed in several distinct characters; (2) populations that differed in a few minor but constant characters; (3) populations that differed in one character; (4) populations that differed in no respect except within the limits of the usual intrapopulational variation.

Obviously the populations in the first category represent good species. Those in the second category are also considered to be good species. The latter populations are found on a given taxon of host. For example, six closely related species found on species in the family Passeridae are similar in size, general shape, and chaetotaxy, but they can be separated by the characters of the mandibles, the pigmentation pattern on the sternites, and minor constant differences in the shape of the head and gular plate. The differences are considered to be of specific value, whereas the similarities are interpreted as the result of adaptations to a common environment afforded by the similarities in the size and plumage of the warblers.

Populations that differ in only one character are not given taxonomic status. These presumed single differences, such as the intensity of the pigmentation pattern or the shape of the head, are of a type that can be easily altered during curatorial procedures. Examples of these differences are discussed under the remarks for *R. elongatus*, *R. fringillae sensu lato*, and *R. difformis*.

According to Clay (1962) the most controversial topic in *Mallophaga* systematics is how to deal with populations that differ in no respect except for over-all size. There are no data for *Mallophaga* to indicate that size differences result from genetic or from host-induced differences. Mayr et al. (1953) reported that host-determined variation is most commonly expressed in size differences so far as studied. There is a rough correlation between the mean size of the louse population and the size of the hosts in these populations. This phenomenon has been referred to as Harrison's law (Clay, 1962). In view of the uncertainty over the cause of size differences, it appears better for the present not to recognize taxonomically populations that differ statistically only in over-all size. Such populations are referred to as a species *sensu lato*.

Populations that do not differ from each other are considered conspecific. The polygenic distribution (Sandground, 1929) of these species of *Ricinus* and a related genus, *Lomobothrius* (see Nelson and Price, 1965), seem unusual for *Mallophaga*. Other groups of lice appear to be strictly monogenic (Ward, 1957) or oligogenic (Koller, 1958), except for some species that have been referred to the *sensu lato* status by Clay (1962) and Price and Beer (1963). No adequate explanation is available to account for this lack of speciation. Both of the genera above are considered by Hopkins (1949) to be relict. Lack of speciation and disjunct distributions seem to be characteristic of relics.

Carson (1959) has outlined a hypothesis that accounts for species formation and species retardation based upon contrasting types of genetic adjustments exhibited by various populations. Adjustment by homoselection (selection for specific performance in a specific niche) results in genetically fixed adaptive features. Species formation is promoted since populations are small, inbred, and semi-isolated; random drift may operate and open recombination usually prevails. Adjustment by heteroselection (selection for general performance in all niches) results in genetic balance with the property of heterotic buffering. Species formation is retarded since populations generally are very large and outcrossed with little isolation; random drift rarely operates and restricted recombination often prevails. Wenzel and Tipton (1966) stated that Carson's concept of homoselection versus heteroselection seems to apply to populations of host-limited and non-host-limited parasites, respectively. The concept does seem applicable to species of *Ricinus* that exhibit monoxenism and perhaps oligoxenism, but not to those with a wide host association. In the later the concept of heteroselection seems applicable only if it is assumed that enough interspecific transfer occurs to create the large population required by the hypothesis and to prevent random drift and isolation.

No populations are referred to the subspecies taxa. Johnson (1959) showed that the subspecies in lice has not been based on geographical variation or a zone of intergradation. Thus none of the described subspecies of *Mallophaga* conforms to the definition given by Mayr et al. (1953). Currently no adequate data are...
available upon which to base decisions on the subspecific status of Mallophagian populations. Hall (1943) has presented a reasonable method for determining whether populations of mammals on islands should be considered species or subspecies. He used the amount of variation on the mainland as his baseline. This type of analysis might demonstrate subspecies in lice if a baseline for the total variation of a species throughout its range could be established. Until this is done the subspecies concept serves no useful purpose as applied to lice (Clay, 1962; Ricketts, 1968).

**PHYLLOGENY**

Since fossils of lice are unknown, deductions as to the origin and phyllogeny of Mallophaga must be based on data collected from comparative anatomy of extant forms. Problems associated with the interpretation of these data are discussed by Clay (1947, 1948, 1957) and Keler (1957, 1958). Owing to much apparent convergence and parallelism among lice, it is difficult to ascertain which characters have phylogenetic significance and hence which show the primitive or derived state (Clay, 1947). Mayr (1954) has pointed out that as an almost regular occurrence a structure begins in a simple condition, becomes complex later in its evolution, but is eventually again simplified. Furthermore, he stated that the more important the structure is functionally, the more plastic it will be in evolution. With these cautions in mind, there yet appears to be a reasonable and plausible choice of characters that demonstrate the probable phylogenetic position of Rictus within the Mallophaga and the apparent phyllogeny within the genus.

It is generally acknowledged that the tentorium is useful in determining relationships throughout the Insecta. In the genera Rictus and Laemobothrius Symons (1952) found greater reduction of the tentorium than in other Mallophaga. Coupled with this reduction is the loss of frontoclypeal and postoculitc sutures in nymphs and adults of Rictus. Loss of these landmarks and reduction of the tentorium are interpreted as evidence of specialization.

Specialization of the mandibles of Rictus has occurred in several ways. My observations have shown them to be relatively smaller and less heavily sclerotized than in the other genera of Amblycera. In the genera Rictus and Laemobothrius Symons (1952) have found greater reduction of the tentorium than in other Mallophaga. Coupled with this reduction is the loss of frontoclypeal and postoculitc sutures in nymphs and adults of Rictus. Loss of these landmarks and reduction of the tentorium are interpreted as evidence of specialization.

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Further specialization in Rictus is evidenced by the fusion of the elements comprising the pterothorax of the terminal segments of the abdomen, and of the selerites of the male genitalia. The pterothorax, which comprises the mesothorax and abdominal segment I, has become fused to the extent that no external traces of division are apparent. According to Cope (1943) there is at least some external evidence of division of these elements in other Amblycera. Abdominal segments IX and X have become coalesced in both sexes, but Cope stated that this phenomenon has occurred repeatedly in the Mesoponidae. The male genitalia are quite simple in Rictus compared to those of other genera of Amblycera (Snodgrass, 1923). Although the homologies of the various structures of the male genitalia are difficult to ascertain (Clay, 1956), it is apparent that the endomeses have become either lost or fused with the mesosome.

In Rictus, Laemobothrius, Trochilacetes, and Trochiliphaga the antennal capsules are situated ventrally on the head rather than laterally as in other genera of Amblycera. The ventral position of the antennal capsules is regarded as the specialized condition. This reasoning is based on the fact that genera with ventral capsules have the most reduced tentorium. The same reasoning is used with regard to the sparsity of setae exhibited by Rictus. Newly all other Amblycera are moderately or heavily setose. The reduction in the number of setae is considered a specialized character. Based upon the evidence of the modifications discussed above, it is concluded that Rictus is one of the most specialized genera in the suborder Amblycera.

Evolution within Rictus is evidenced by further specialization of certain structures and the development of common features in various groups of species. The combination of these results in data that are useful in deducing the probable phyllogeny of the various species groups. A dendrogram (pl. 1) shows the hypothetical phyllogeny of species of Rictus. Modifications that show apparent phylogenetic sequence are seen in the mandibles, (dimorphic, monomorphic, or intermediate) and tentorium.

It is generally agreed that in insects the chewing mouthparts are primitive, whereas piercing-sucking mouthparts are specialized. The mandibles in insects that masticate their food are polymorphic (Snodgrass, 1935). In the Mallophaga the Ischnocera feed almost exclusively on feathers and skin debris. The Ischnocera have homomorphic mandibles, as illustrated by Keler (1957). Most of the Amblycera feed on feathers, skin debris, and blood. Herein the mandibles are dimorphic, but the tips are more pointed—probably an adaption for piercing (Keler, 1957). In Rictus both dimorphic and monomorphic mandibles occur. Species of Rictus with dimorphic mandibles are considered more primitive.

The development of monomorphic mandibles represents a departure from the basic kind found in the Mallophaga and is considered the specialized form. The monomorphic form probably represents a more efficient structure for piercing. Among the species with monomorphic mandibles those with short, thick mandibular tips, those with long needle-like tips, and those with mandibles that show various intermediate conditions in the structure of the tips. The long needle-like tips seem to represent the specialized form, being derived from the shorter, thicker type.

Modifications of the mandibles appear to be correlated with a reduction of the tentorium. The tentorium is best developed in species with dimorphic mandibles,
giving further support to the concept that these species are more primitive. Among these species the posterior tentorial pits are large and the tentorial arms are sclerotized. Among species of *Ricinus* with monomorphic mandibles the tentorium is best developed in members with short, thick mandibular tips; even so, the posterior pits are reduced and the arms appear membranous. In the species with needle-like mandibular tips the arms are rarely evident and the posterior pits are quite small or absent. The two species with the intermediate type of mandibles have relatively well-developed tentorium.

The species with diphomorphic mandibles are divided into three groups: the *brevicapillus*, *arcuatulus*, and *fringilliae* groups. The first two groups appear to be related, but since the male of the only species in the *brevicapillus* group is unknown, the degree of relationship is unknown. These two groups are considered the most primitive of the extant species of *Ricinus*, whereas the *fringilliae* species group is the most advanced of the species with monomorphic mandibles. Evidence for this is seen in the structure of the male genitalia and the host association of these groups. The genitalia of the *arcuatulus* group have long, pointed parameres with apical setae. The margin of the mesosoma ends in a broad plate or a sharp point. The genitalia of the *fringilliae* group have rounded parameres without apical setae. The margin of the mesosoma is entire. The latter type has probably been derived from the former. Furthermore, the *brevicapillus* and *arcuatulus* groups are found on the subolesines, the primitive passiflorines, whereas the *fringilliae* group occurs on the oecininae, the advanced passiflorines.

Among the species with monomorphic mandibles there has been an apparent progressive reduction both in the mandibular tips, from a short, thick structure to a long, needle-like structure, and in the tentorium. Species with long needle-like tips are not closely related to each other. Development of this kind of tip appears to have evolved independently within three different lines. Each line or species group is characterized by a particular type of ovipositing apparatus in the hypopharyngeal region by the shape of the head. The *subangulatus* species group is characterized by a fundamentally ovipositing stylet (pl. 31, fig. 2), and by the basic head shape (pl. 31, fig. 1). *Ricinus subangulatus* and *R. wolff* represent the primitive numbers of this group, having short, thick mandibular tips, whereas the five other species in this group are advanced, having long needle-like tips. The *diffusus* group is characterized by the presence of finely pitted ovipositing stylets (pl. 31, fig. 3) and by the basic head shape (pl. 31, fig. 1). This group is quite homogeneous, with moderately thick mandibular tips. *R. carolinianus*, *R. sittae*, and *R. australis* are the species with needle-like tips. The *marginatus* species group is distinguished by ovipositing stylets that are visible or unornamented when observed at high magnification, and by the basic head shape (pl. 21, fig. 1). Needle-like tip occur in *R. dentirostris*, *R. fuscans*, *R. poliophilus*, and *R. setasi*.

*Ricinus serratus* has deeply pitted ovipositing stylets as in the *subangulatus* group. However, the unique development of the prothorax and pleural nodi indicates that *R. serratus* should be placed in a separate group. Since this species has short, thick mandibular tips, it is considered to be a primitive offshoot of the line that gave rise to the *subangulatus* group.

In *R. invadens* and *R. mandibulatus* the mandibles show an intermediate condition between the species with diphomorphic mandibles and those with monomorphic mandibles. Other characters these forms are closely related to species with monomorphic mandibles. *R. mandibulatus* superficially resembles *R. marginatus* in the shape of the head and prothorax. Furthermore, the ovipositing stylets are not evident. If convergence has not occurred, these characters are sufficient evidence to place *mandibulatus* near the base of the line that gave rise to the *marginatus* species group. Placement of *R. invadens* within the proposed phylogenetic schema is difficult because it shares characters in common with the *arcuatulus*, *marginatus*, and *subangulatus* groups. Therefore it is considered a separate offshoot, but its exact position cannot be determined.

In summary, it appears that *Ricinus* evolved either from a protomonopodous (Kefer, 1957) or from an early monopodous ancestor about the time of the origin of passerine birds. Two separate radiations have taken place within the genus. The first involved forms having diphomorphic mandibles; these species probably parasitized the progenitors of the modern families of passerines. The second radiation involved forms having monomorphic mandibles. Evidence cited above indicates that monomorphic mandibles evolved from diphomorphic mandibles; therefore, species with monomorphic mandibles must have radiated later than those with diphomorphic mandibles. The forms with monomorphic mandibles are more successful in terms of number of species present in the New World, as 26 as opposed to 10, and in the extent of the distribution in the New World, as 34 as opposed to 8 families of hosts.

The distribution of *Ricinus* on a world-wide basis is interpreted as a relief distillation (Hopkins, 1949). It is speculated that the forms having diphomorphic mandibles were unable to cope with the changes of their hosts and hence became extinct or most of their range. Thus the present distribution of *Ricinus* is basically the result of secondary absence of families with monomorphic mandibles. The species with monomorphic mandibles probably developed during the decline of forms with diphomorphic mandibles, and after the development of most of the passerine families. Thus the distribution of forms with monomorphic mandibles may be basically primary, with little secondary absence. Undoubtedly secondary infestations have occurred to account for some of the distribution of *Ricinus*. Although this hypothesis is highly speculative, it appears to be consistent with the available data on morphology and host association.

**HOST-PARASITE EVOLUTION**

Kellogg (1896, 1913) and Harrison (1914) independently hypothesized that the distribution of Mallophaga is useful in elucidating the phylogeny of their hosts. This hypothesis developed from observations that related hosts harbor related Mallophaga. According to Hopkins (1949), it is based upon the following assumptions:

1. Mallophaga are usually extremely specific, permanent parasites of their hosts.
2. Mallophaga were present on the original ancestors of their hosts and have diverged as their hosts diverged, although at a slower rate.
3. Line have undergone relatively slow evolutionary development.

It was concluded that the occurrence of a genus oflice on a taxon of hosts is indicative of a close relationship of these hosts. Several authors have shown that the distribution of lice can be useful in deducing probable host relationships (Hopkins, 1912, 1914; Clancy, 1949, 1957; Ward, 1957). Although other authors regard
the hypothesis as tenable, they have raised the question how far it may be pursued (Ferris, 1951; VanZandt and Guimaraes, 1955; Mayr, 1957; Kelner, 1957, 1958). They have noted that some of the data on host association of lice contradict the data on the host’s morphology with reference to the phylogeny of the hosts, and have cited instances in which the same species or genera of lice occur on obviously unrelated hosts.

Criticism can be leveled against both the assumptions upon which the hypothesis is based and the interpretations of the observed distribution of lice. The assumptions that are basic to the hypothesis of Kellogg and Harrison are not entirely accurate. The first assumption is that Mallophaga are extremely host-specific, but Kelner (1958), Emerson (1964a, 1964b), Nelson and Price (1965), and the present work show that many species have wide host associations. The second is the implication that secondary infestations have not occurred. Observations cited above show that interspecific transfer is possible and has occurred. In view of these facts it is necessary to determine whether the distribution of a taxon of Mallophaga over one or more taxa of hosts is primary, and can be used to indicate a phylogenetic relationship of the hosts, or is secondary, and only implies an ecological relationship of the hosts. Since it is rarely possible to determine this directly, the best interpretation is made on the basis of all available data regarding the biology and evolutionary history of lice and their hosts.

For example, each of the genera Coleopterus, Laconobothrius, and Menacanthus occurs on four or more unrelated orders of birds (Clay, 1857). Since it is difficult to comprehend how contact could occur between certain of these species, Hopkins (1949) and Clay (1949b, 1957) speculated that these lice were more widely distributed over the orders of birds, but have become extinct over part of their former range. The fact that ducks and flamingoes share certain genera of lice has led Hopkins (1942) and Clay (1957) to conclude that a phylogenetic relationship exists between these superficially dissimilar birds. Because both groups of birds live in similar habitats, flamingoes may have acquired lice from aquatic birds through direct or indirect contact, indicating only an ecological relationship between these hosts (Mayr, 1957). However, Clay supported her assumption with data from the fossil record and from comparative morphology of the plumage of these birds. Problems in interpreting the distribution of several species of Ricinus are discussed below.

Mayr (1957) stated that evidence of phylogenetic relationship presented by previous authors may be suggestive, but can rarely be considered absolute proof unless it is corroborated by independent evidence. Furthermore, Ferris (1951) admonished that discrepancies between data from host association and host morphology should be accepted as they exist and not forced into some framework of ideas as to how they ought to be accounted for by the system of classification. Therefore it is concluded that data from host-parasite association should be considered only as circumstantial evidence affecting the interpretation of phylogenetic relationships of avian hosts as established by classical ornithological methodology.

Ricinus occurs on 25 of the 70 families of Passeriformes (table 2). Hopkins (1942, 1949) interpreted this as a relic distribution, since these 25 families are not closely related. Because of this type of distribution, he suggested that no reliance be placed on the use of Ricinus in determining relationships of these birds. How-

**TABLE 2**

<table>
<thead>
<tr>
<th>Old World</th>
<th>New World</th>
<th>Both Old and New World</th>
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</thead>
<tbody>
<tr>
<td>Dicruridae</td>
<td>Corvidae</td>
<td>Alaudidae</td>
</tr>
<tr>
<td>Oriolidae</td>
<td>Paridae</td>
<td>Paridae</td>
</tr>
<tr>
<td>Fulvousoxyidae</td>
<td>Paridae</td>
<td>Tyrannidae</td>
</tr>
<tr>
<td>Paradipoidae</td>
<td>Coerebidae</td>
<td>Vireonidae</td>
</tr>
<tr>
<td>Fyornithidae</td>
<td>Paridae</td>
<td>Sylvidae</td>
</tr>
<tr>
<td>Muscicapidae</td>
<td>Sylvidae</td>
<td>Sylvidae</td>
</tr>
<tr>
<td>Furnariidae</td>
<td>Fringillidae</td>
<td>Regulidae</td>
</tr>
<tr>
<td>Sturnidae</td>
<td>Fringillidae</td>
<td>Regulidae</td>
</tr>
<tr>
<td>Meliphagidae</td>
<td>Fringillidae</td>
<td>Regulidae</td>
</tr>
<tr>
<td>Nectariniidae</td>
<td>Fringillidae</td>
<td>Fringillidae</td>
</tr>
</tbody>
</table>

Certain species groups of Ricinus are useful in demonstrating relationships of some groups of birds, but in other species groups the distribution is so anomalous that definite correlations cannot be made. If the species groups of lice that contain only one species of Ricinus are eliminated from the discussion, the following relationships are indicated. The arcuatus and fringillaria species groups show specificity at the superfamilial and subordinal level of hosts, with the former occurring on members of the Tyrannidae of the suborder Tyranni and the latter on members of the suborder Passeres. Except for B. citrinus from Sittidae, the diffusus group shows specificity at the family level, occurring on members of the Fringillidae (sensu Wetmore, 1960). The subrugulosus species group is found on Vireonidae, Thrapiidae, and Fringillidae. Becher (1953) and Tordoff (1954a, 1954b) both recognize the close relationship of these “primaried” New World species. However, the family Parulidae, also a member of this group of birds, harbors species of Ricinus placed in the marginatus species group. Species from Tyrannidae and Regulidae are also included in the marginatus species group. Because of their anomalous distribution, the usefulness of the subrugulosus and marginatus groups as indicators of host phylogeny is highly speculative.

**Species of Ricinus demonstrate various degrees of host specificity (table 3).** Of the 28 species recognized in the New World, 24 percent show monoxenia or host specificity at the species level. Since collecting records are incomplete, this figure may be high. However, strict host specificity presently cannot be ruled out. Host specificity at the generic level occurs, as is indicated by Ricinus spp. listed as oligoxenic in table 3. Host specificity at the family level also occurs. Ricinus that
show this type of specificity are the only representatives of the genus or a species group that occur throughout that particular family of birds. These species are as follows: *R. invadens* of the *invadens* species group and *R. pezizalis* of the *arcatus* species group on Pipridae; *R. japonicus* on Motacillidae; and *R. serratus* on Alaudidae.

Species that show an apparent secondary distribution on avian hosts are *R. elongatus* and *R. frigillae* sensu lato. *R. elongatus* occurs on species in the avian genus *Turdus* (family Turdidae) in both the Old and New World and on Rombya.

**TABLE 3**

Degree of Specificity Exhibited by Species of *Ricinus* (Terms after Sandground, 1920)

<table>
<thead>
<tr>
<th>Monogenus</th>
<th>Cephalon</th>
<th>Polygenus</th>
</tr>
</thead>
<tbody>
<tr>
<td>compresus</td>
<td>brevispathis</td>
<td>arcatus</td>
</tr>
<tr>
<td>doliplathy</td>
<td>salivari</td>
<td>australis</td>
</tr>
<tr>
<td>fuscomaculatus</td>
<td>carvalensem</td>
<td>difflus</td>
</tr>
<tr>
<td>vanhouttei</td>
<td>dentratenex</td>
<td>elongatus</td>
</tr>
<tr>
<td>microcephalus</td>
<td>frenatus</td>
<td>elongatus</td>
</tr>
<tr>
<td>pellus</td>
<td>longipennis</td>
<td>elongatus</td>
</tr>
<tr>
<td>polypothium</td>
<td>simplex</td>
<td>elongatus</td>
</tr>
<tr>
<td>raphnocolis</td>
<td>verrernex</td>
<td>japoinicus</td>
</tr>
<tr>
<td>surus</td>
<td>subfuscus</td>
<td>lepisma</td>
</tr>
<tr>
<td>sylvis</td>
<td>unifloridus</td>
<td>margaritatus</td>
</tr>
<tr>
<td>thoracicus</td>
<td>vermicomum</td>
<td>pinnaxalis</td>
</tr>
<tr>
<td>volatilis</td>
<td>pterulatus</td>
<td>pterulatus</td>
</tr>
<tr>
<td>gibbus</td>
<td>rubrofuscus</td>
<td>serratus</td>
</tr>
<tr>
<td>pinnaxalis</td>
<td>nigrofuscus</td>
<td>subfuscus</td>
</tr>
<tr>
<td>gibbus</td>
<td>rubrofuscus</td>
<td>subfuscus</td>
</tr>
<tr>
<td>gibbus</td>
<td>rubrofuscus</td>
<td>australis</td>
</tr>
</tbody>
</table>

_Nelson: Revision of the New World Species of *Ricinus*_

Some species of *Ricinus* may indicate a phylogenetic relationship of some of these birds, it is possible that this relationship has become obscured by secondary infestations onto other species of hosts that are associated ecologically with these birds.

Species of *Ricinus* are suggestive in clarifying controversial theories or supporting various hypotheses on the classification of their hosts. The distribution of *arcatus* supports the views of Dr. P. L. Ames and Dr. S. L. Warton (unpublished, cited in De Schauensee, 1960) that some genera currently placed in Carduelinae belong to Tyrannidae. *R. arcatus* occurs on some genera of tyrannids and on two corvids, *Pachyrhynchos* and *Ptilogena*. These are two of the genera that Ames and Warton considered as tyrannids, based on a study of the osteology and the syrinx.

The close relationship of *R. subhastatus*, found on *Pipilo* and *Chlorura*, and *R. wolf* on *Atornopia* supports the suggestion of Marshall (1964) that *Pipilo* and some members of *Atornopia* are closely related. Marshall based his evidence on similarities between the behavioral patterns and calls of these birds. However, since these genera are ground-dwelling birds, the distribution of associated species of *Ricinus* may indicate only an ecological relationship of the avian hosts.

The avian families Thrupidae and Fringillidae have been the subject of much recent study. The proper allocation of genera and subfamilies traditionally placed in these families has been obscured by much convergence and parallelism in various structures. Most ornithologists consider these families as heterogeneous groups (Beecher, 1955; Toordse, 1954a, 1954b; Mayr, 1955; Weimor, 1960; De Schauensee, 1966). Toordse, basing his evidence on the morphology of the palatal region of the skull, placed certain members of the fringillid subfamily Richardeniinae in the family Thrupidae and placed the fringillid subfamily Carduelinae in the family Ploceidae (an Old World family). The distribution of species of *Ricinus* suggests that Richardeniinae has a diesel origin, if no secondary transfer of line is assumed. In this subfamily *Volatilis* harbors *R. volatilis*, a species closely related to those species of *Ricinus* found on Thrupids, whereas the *Passerina-Cyanocompsa-Guira* complex in Richardeniinae harbors *Ricinus* australis, a species of the *difflus* group occurring on Fringillidae. Since the species of *Ricinus* found on Carduelinae are closely related to those from the fringillid subfamily Emberizinae, these data suggest that Toordse’s placement of Carduelinae in the Ploceidae is incorrect. The validity of this reasoning is based on the assumption that no secondary transfer has occurred. In further support of this reasoning, Dr. Clay (in litt.) has informed me that *Ricinus* does not occur on Ploceids in the Old World.

Finally, it is extremely interesting that many of the same phenomena regarding types of host specificity in *Ricinus* were found in the acarine genus *Protophylloides* by Atlee and Bransel (1966). These mites also are ectoparasites of Passeriformes, but occasionally occur on other orders. The authors found specificity at the specific, generic, family, and subfamily levels, and examples of species with anomalous distributions. Their statements concerning host-parasite relationships appear to be less subjective than those herein owing to the more even distribution of *Protophylloides* among the families of passerines.
SYSTEMATICS
SYNONYM AND DIAGNOSIS OF THE GENUS RICINUS

Ricinus DeGeer, 1778


Description.—Medium to large Aalobrya; females 2.4 to 5.5 mm and males 1.9 to 4.5 mm in length. Head conical, spatulate, or oval-shaped in shape, depressed. Epipharynx modified into two ventrolateral files, rocker-like lobes. Antennae four-segmented, situated ventrally in cephalic and surmounting partially by labella which are fringed laterally with setae. Two pairs of spinosa or occasionally palpa setae (prosternal process) anterior to antennae; two pairs of para-antennal setae lateral to antennae, variably in length. Anterior margin of head (front) narrowly to broadly rounded or truncate; usually with one pair of short seta dorsally (m) and two pairs of short setae ventrally (s). Dorsum of head with three pairs of short setae. Lateral margins of head straight to slightly concave; marginal carinae bearing four pairs of setae (m series); 1-2-2-2 short, m variable. Temple triangle; each bearing three long setae (s series) dorsolaterally and four to six pairs of short setae dorsally (n series); n variable in length. Three or four setae posteriorly to eye (po series); eyes prominent. Occipital margin concave. Occipital lobes exincised, receiving anterior margin of prothorax; bicorne or conical in outline. Two or three pairs of pigmented nodi dorsally; antennal nodi falcate; terminal nodi separated from fused with hemi nodi; Tastillae reduced; anterior and posterior area membranous; pala and 9-10 exposed; palpus and 9-10 exposed. Galement membranous with 9-10 exposed; palpus and 9-10 exposed. Glandular valves in groove, usually not evident. Labium simple without division into glosso, palatines; and labial; labial palp with 2-3 pairs of setae. Hypopharynx typically membranous; atritophic sensillate; avicinella setae, not evident to evident; when evident, elongated with inner, pigmented plate; bearing two to eight pairs of setae laterally. Posterior apically from pyriform; hexagonal or subcircular in shape; conical anterior and posteriorly; bearing nine pairs of setae laterally (s series); two pairs of short setae dorsally (n series); L1 and L2 short; M1 and M2 short; P2 and P3 absent in two species. L3-L5 spinosa; M5 absent or duplicated in some species; L7 and L8 long and tactile; s variable in length. Preoral plate with lateral pigmented nodi; bearing one pair of short setae anteriorly. One pair of cervical plates; each with two short setae. Suboculars in one or more divided areas. Dorsal plate large, broad and rounded anteriorly, narrow and truncate posteriorly, bearing one or two pairs of short setae; usually one or two pairs of median setae and one pair of median to short posterior setae; usually four pairs of anterolateral spines setae situated dorsally (n series); two to four pairs of spinosa setae situated ventrally (n series); pala; anterior two pairs spinosa; posterior pair plumo. Two pairs of setae on posterior lateral margin. Dorsal submedian nodi pigmented.

Abdomen elongated, margins continuous with posterotermes. Eight apparent segments present (13-14); tergum I-IX acutely equal in size and shape; bearing usually two pairs of setae at posterotermal corners, occasionally only one pair. Tergum IX with four to eight pairs of setae.

Nelson: Revision of the New World Species of Ricinus

terminal setae; number and size showing sexual dimorphism. Spinosa and associated segments present on tergum II-VIII. Pleurople wrap around margin of abdomen; dorsal part of plate bearing one postabdominal seta and one short seta; ventral part with three setae, size and shape. Stereota II-VI each with a pair of postabdominal setae and three or four submedian setae. Male tergum VII-VIII with a pair of postabdominal setae. Female tergum VII-VIII with a pair of postabdominal setae. Male tergum VIII-VIII with a pair of postabdominal setae. Female tergum VII-VIII with a pair of postabdominal setae. Female tergum VIII-VIII with a pair of postabdominal setae. Male tergum IX-VIII with a pair of postabdominal setae. Female tergum IX-VIII with a pair of postabdominal setae. Female tergum IX-VIII with a pair of postabdominal setae. Female tergum IX-VIII with a pair of postabdominal setae.

Remarks.—Species of the genus Ricinus are found exclusively on hosts of grass of the 70 families of Poaceae (Weissman, 1980). All of the families on which Ricinus occurs is given in table 2.

Distributions.—Species of the genus Ricinus are found exclusively on hosts of grass of the 70 families of Poaceae (Weissman, 1980). All of the families on which Ricinus occurs is given in table 2.

The species of Ricinus found on passerines appear to comprise a homogeneous taxon. Although certain well-defined species of passerines appear within the genus, most of them are related to others by species of intermediate structure. Modifications that have developed are interpreted as the result of evolutionary trends and subsequent radiation within the family. Recognizable groups of species are defined by the species group status. The use of this nomenclatural category is sufficient to show probable relationships among the New World species.

KEY TO THE NEW WORLD SPECIES OF THE GENUS RICINUS

1. Mandibular tips and lobes dimorphic; left mandibular lobe with knoblike extension (pl. 3, fig. 9); two nodi on head (ventral and lateral); a3 absent; maxillary palp not pigmented
2. Mandibular tips monomorphic; mandibular lobes with or without knoblike extension; three nodi on head (dorsal, lateral, and external); a3 absent; maxillary palp pigmented... 11
2. Head conical; antennal lappets each with 35 setae; body heavily pigmented; terminal head sutures or submedian; antennal lappets each with more than 15 setae; body varicose pigmented, but terminal segment not hyaline

3. Head sutures or submedian; antennal lappets each with more than 15 setae; body varicose pigmented, but terminal segment not hyaline
3. C4 absent; a1 short; a2 present; b1 short; head spatulate; parameres pointed with apical setae.

4. C4 present; a1 long, C4 absent; b1 long; head subcylindrical, chunky; parameres rounded without apical setae.

5. L7-L9 long and equal; penultimate penultimate


7. Penultimate pair; sternal plate bearing one pair of disc setae just anterior to "eyes" of diffuse, shell-like pattern (pl. 4, fig. 3); parameres without lateral setae.

8. Inner pair of parameres long; sternal plate bearing two pairs of long setae, without the pattern above pl. 4, fig. 2.

9. Parameres present on inner and outer margins.

10. Labium with 12 pairs of setae; nodi of prothoracic plate and pleurites broad; lateral setae of parameres present on inner and outer margins.

11. Prothorax hexagonal; al with two sensilla; ml longer than m2; margin of mesosoma ending in a small, sharp point.

12. Prothorax subhexagonal; al with one sensillum; ml shorter than m2; margin of mesosoma ending in broad plate.

13. Mandibles as in pl. 15, fig. 2; labium with 17 to 19 pairs of setae; temples rounded; two long tactile setae on coxae I-II and trochanters III-IV; prothorax plate showing sexual dimorphism.

14. Mandible otherwise; labium with 15 or fewer pairs of setae; spines of temple absent; one pair of tactile setae on coxae I-II and trochanters III-IV; prothorax plate showing sexual dimorphism.

15. Setae q2 and q3 present; two pairs of long setae on sternal plate; pattern on gular plate.

16. Head elongated (pl. 11, fig. 1); marginal emargination narrow at insertion.

17. Maxillary plates relatively narrow; tergal setae on head, as in pl. 4, fig. 1.

18. Maxillary plate relatively wide; tergites unmodified, white.

19. Labium with 12 pairs of setae.

20. Labium with 14 pairs of setae, gular plate with three or four pairs of setae; total length of females greater than 3.8 mm.

21. Labium with 13 pairs of setae, gular plate with three or four pairs of setae; total length of females greater than 3.8 mm.

22. Prothorax broad, as in pl. 38, fig. 4; head much wider than long; setae on ventral pleurites IV strongly spinose; transverse carina rounded, but not arched.

23. Mandibles as in pl. 4, fig. 2; head as in pl. 17, fig. 2; al absent; ml longer than m2.

24. Mandibles as in pl. 4, fig. 2; head as in pl. 17, fig. 2; al absent; ml longer than m2; m2 long, m3 short; m2 and m3 relatively equal.

25. Mandibles as in pl. 15, fig. 1; head as in pl. 17, fig. 1; al absent; m2 long, m3 short; m2 and m3 relatively equal.

26. Mandibles as in pl. 4, fig. 3; head as in pl. 17, fig. 3; al absent; m2 long, m3 short; m2 and m3 relatively equal.

27. Mandibles as in pl. 4, fig. 2; head as in pl. 17, fig. 2; al absent; m2 long, m3 short; m2 and m3 relatively equal.

28. Mandibles as in pl. 4, fig. 1; head as in pl. 17, fig. 1; al absent; m2 long, m3 short; m2 and m3 relatively equal.
## TABLE 4

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**Description of the Species**

*R. brevicornis* Species Group

**Diagnostic Characteristics**

1. Head conical with margins of frons continuous with that of marginal carinae.
2. Type of mandibles dimorphic; left mandible huge with knob or angular-like articulation.
3. Ovipositor not evident.
4. Setae at long, each with two sensilla; 1:26 present.
5. C. nuclea.
6. Terminal tergite and anal lappets lunate.

**Remarks**

The *brevicornis* species group consists of a single species, *brevicornis*. The unique features exhibited by this species warrant recognition as a separate group. Perhaps the undescribed form of *R. brevicornis* from *Schizophora* (Pipidae) referred to by Carriker (1964) will prove to belong to this group.

**R. brevicornis Carriker, 1964**


**Diagnosis**

A large, heavily sclerotized species with characters of the *brevicornis* species group. Closely related to *R. arcuata* but differing in shape of head and labials. Setae at long and equal to or greater than labial setae. Tergites large and U-shaped. Terminal segment and anal lappets separate; legs hyaline. Tactile setae on all femora. Number of setae along anal lappets: 35–35. Setae of tergites and sternites of abdomen long, 1.6 long and widely separated; 1.0 short, placed posteriorly. 0.4 present.

**Description**

Head conical, wider than long, as in *R. arcuata*; labials as in *R. arcuata*; setae at long and equal to labial setae. Palps reaching margin of head; palpal setae of segment one as long as length of second palpal segment; spinose. Preanal setae spinose. Setae at long and equal to or greater than labial setae; setae at short, placed posteriorly; several setae in 1.6 position. Preanal segment as in *R. arcuata*; setae at short and equal to labial setae; setae at short, placed posteriorly; several setae in 1.6 position. Postanal segment as in *R. arcuata*; setae at long and equal to labial setae; setae at short, placed posteriorly; several setae in 1.6 position. Postanal segment as in *R. arcuata*; setae at long and equal to labial setae; setae at short, placed posteriorly; several setae in 1.6 position.

**Terarginal Segments of Females of abdomen as in *R. brevicornis*; setae at long and equal to labial setae. Vental margin with ten setae. Excluding setae and terminal setae, legs hyaline.

**Terminal Segments of Females of abdomen as in *R. brevicornis*; setae at long and equal to labial setae. Vental margin with ten setae. Excluding setae and terminal setae, legs hyaline.

**Dimensions**

Dimensions are given only for the type species. The type of *R. spadix* Carriker is *R. brevicornis* and is so described that most dimensions of this species are not typical. Total length 5.4 mm; greatest width 1.46; head length 0.97; head width 1.11; labral width 0.84; prothoracic length 0.63; pronotum width 1.08.

**Distribution**

Known from young species, one each from two species in genus *Tityra* family Cotingidae.

**Material examined**

From *Tityra arsenius* (Columbidae: Eidnygusy: holotype 1 (USNM 68718); from *La Cumbre de Valenciana*, Venezuela, on 24 September 1915 by M. A. Carriker, Jr.

**Remarks**

Described *R. brevicornis* and *R. spadix* from two species of *Tityra*, family Cotingidae. *R. spadix*, however, is so described that the head, maxillary plates, mandibles, and labrum are distorted. Carriker differs...
Ricinus araucarias Species Group

**Diagnostic Characteristics**

1. Head subturbate; frons broadly elliptical without frontal transverse carina, margin of frons continuous with that of marginal carina, which are nearly straight; temple narrow, not expanded; dorsal occipital margin broadly elliptical, flattened medially; occipital nodus truncate medially.

2. Mandibles dimorphic; left mandible larger, receiving tip of right mandible; bearing a mandible extension on mandibular lobe which articulates with right mandibular lobe.

3. Margin of labium rounded.

4. Maxillary plates large, rectangular in shape; palpi straight or weakly geniculate.

5. Pulvilli well developed; labial nodal absent.

6. Ovipositor short, without oviscap, rounded, usually not evident; unornamented.


8. Dorsal and ventral.

9. Sexes alata present.

10. Testis testis absent on female except for one pair on femur I in *R. proctorii*.

11. Preputial sac shaped like a bouquet of cut flowers.

12. Parameters relatively narrow.

**Ricinus araucarias (Kellogg and Mann, 1912)**

**Phytothemus fasciatus var. acutus** Kellogg and Mann, 1912, Edward News 23:65. Type locality: Panama, California. Type host: *Vaccinium corymbosum* (now *Vaccinium corymbosum* Revislon).


**Type locality:** Maripas, Rio Cuente, Venezuela. Type host: *Rhyt(i)pierca simplex* Frederick Bangs and Kendall. New synonym.


**Type locality:** Laguna de Arco, Yaracuy, Venezuela. Type host: *Polynema hystrix* (Holocerus) (Nekyn). New synonym.

**Ricinus proctori major Carriker, 1964, Mem. Soc. Cien. Nat. La Salle 24:25, figs. 3, 4.**

**Type locality:** Lake Mucum, Tucuy, Venezuela. Type host: *Pachyphantes polycheleptus* Carriker (Krapfl). New synonym.


**Type locality:** Lake Mendon, Tucuy, Venezuela. Type host: *Pachyphantes polycheleptus* Carriker. New synonym.


**Type locality:** near Villa Nova, Sierra Perija, Venezuela. Type host: *Pachyphantes polycheleptus* Carriker. New synonym.

**Mean and Range of Measurements of Females of *Ricinus araucarias* Populations**

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<td>Total length</td>
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<td>3.84 (n = 3)</td>
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**Prochoras** as in pl. 4, fig. 3; 1A-10 long, ventral proctodeum as in pl. 4, 5, 2; inner margin never indented, entire. Setae pPr shorter than cPr. Distal spine on cPr only typical; median two spines setae subequal. Spines setae on dorsoepisteme margin of proctodeum. Setae pPr with one pair of setae just anterior to "eyes" of diffuse scale-like pattern on sternal plate, pl. 4, fig. 3; posterior setae pPr long as or longer than the anterior setae. Setae cPr slightly longer than cPr, both spines: W series variable; W-1 to W-10. Average W-8. Setae hPPr present. Three to two spine setae on cone II and III, respectively; v long tarsal setae on cone II. Femora I and II with lateral unpigmented patches one-third distance from distal ends. Terminal segments of abdomen and female terminalia as in pl. 5, 6, 2. Pleuropsis pigmented; noldi broad; pattern of setae on ventral pleurites as given in table. Inner forgal setae half as long as postspinular setae. Stereocerotic and sternebral setae of sternites III-VI nearly equal. Ventral margin with 20 to 32 setae, average 25. Male genitalia as in pl. 4, fig. 2; parameters each with four spiral setae.
Nelson: Revision of the New World Species of Reticulatus

This species is heavily pigmented; color dark brown on brown background. Dimensions.—See tables 5 and 6.

Distribution.—Known from genera Tyrannus, Maxillaris, and Pitangu from Tyrannidae and Pachyramphus and Rhytiphona in Cotingidae. Materiai examined.—From Tyrannus vociferous Swainson: 2 heterotype and 9 paralotype (VLK 169-185) from Paso Robles, California; no other data; 1 2 3 2 (BMNH 21770) from California in February 1939 by E. Meinertzhagen. From Tyrannus verticalis Say: 2 2 2 8 N (BCN) from West Drain, Kern Co., California, on 9 August 1962 by James Bruce; 2 (VLK) from near Santa Cruz, California, on 1 July 1924 by K. Rett; 1 2 1 (BCN 698) from Hopland Field Station, Mendocino Co., California, on 6 June 1965 by B. C. Nelson; 2 (UM 126-127) from Delta, Manitoba, Canada, on 2 August 1961 by David Olson. From Tyrannus tyrannus (Linnaeus): 1 2 (BCN 729 in USNM) from Miami, Florida, on 27 August 1918 by J. A. Weber; 1 2 (INHS) from Urbana, Illinois, on 26 June 1922 by H. H. Rose; 1 2 (USNM) from Durham, Strafford Co., New Hampshire, on 19 July 1965 by J. E. Kelso; 1 2 (CU) from Ithaca, New York, in 1928; 1 2 (CU) from Hyak Perimeter, Albany Co., New York, on 9 July 1964 by R. C. Delgosto; 1 2 (USNM) from Sheldon, North Dakota, on 19 July 1969 by W. G. Bruce; 2 2 from Adel, Oregon, on 19 August 1960 by Alex Walker; 1 2 (UW) from Arava, Ontonagon Co., Wisconsin, on 31 May 1922 by W. F. Woodman. From Tyrannus melanochlomus Vieillot: 1 2 (BMNH) from Kanaza Mts., Bopassou, on 23 February 1942 by Theron Clay. From Tyrannus dominicu (Gmelin): 1 2 (CU) from Puerto Rico; 1 2 (USNM) from Guanacaste, Costa Rica, on 5 July 1938 by S. T. Dandroit; 2 2 (USNM) from Bahama Is., Fortuna Is., on 12 July 1939 by H. B. Peters; 2 2 (USNM) from Abilene Is., B.W.I., on 10 March 1930 by H. B. Peters; 1 2 (USNM) from Little Inagua Is., B.W.I., on 5 August 1930 by H. B. Peters; 2 2 (USNM) from Great Inagua Is., B.W.I., on 8 August 1930 by H. B. Peters; 2 2 (BMNH 19238) from Bahamas by D. Meinertzhagen. From Maxillaris tyrannus (Linnaeus): 4 2 (USNM) from Ticonatajuyu, Mexico, on 8 February 1949; 1 2 (USNM) from Sun Sebaste, B.N. de Sta. Marta, Colon, on 2 March 1964; 1 2 (USNM) from Antatiquy, Canton, Venezuela, on 6 September 1948, all collected by M. A. Carriker, Jr. From Penatops melanochlomus (Linnaeus): 2 2 (USNM) from Venezuela Casista, Colombia, on 3 June 1952 by M. A. Carriker, Jr.; 1 2 4 2 (BMNH-MRVL 13913) from China, Tiancoo, from Penatops melanochlomus melanochlomus (Rafinesque) on 27 May 1980 (USNM 68745), holotype of E. mucronatus (Rafinesque) from Lagonia de Arro, Edo. Yaracuy, Venezuela, on 10 December 1910 by M. A. Carriker, Jr. From Pachyramphus polygamy (Sick or) (USNM 68750, holotype of E. polygamy) from same locality as above on 10 December 1910 by M. A. Carriker, Jr. From Pachyramphus polygamy (Sick or) (USNM 68750, holotype of E. polygamy) from Sierra Perija, from Villanueva, Colombia, on 8 July 1945 by M. A. Carriker, Jr. From Pachyramphus polygamy (Raff.) (USNM 68750, holotype of E. polygamy) from Trinidad, Yaracuy, Venezuela, on 27 April 1927 by M. A. Carriker, Jr. From Penatops melanochlomus (Sick or) (USNM 68750, holotype of E. melanochlomus) from Morro, Rio Carpa, Venezuela, on 20 December 1969. From "Schwartz": obviously a straggler; 1 2 (CU) from Costa Rica.

Remarks.—R. arcuratus occurs on various genera in the Tyrannidae and on two genera, Rhytiphona and Pachyramphus, currently considered to be Cotingidae. Except for differences in overall size, there are no consistent differences in the shape of structures, pigmentation patterns, or osteology to differentiate between these populations. The differences in width of the head and abdomen in specimens from Maxillaris and Pitangus are in part the result of shrinking due to improper mounting. Inclusion of populations from cotigid species in R. arcuratus is discussed below in the remarks under L. leptosomus.

The distribution of R. arcuratus seems to indicate a close relationship between the infected genera. de Schauensee (1966) has indicated that there is a difference of opinion among ornithologists regarding the correct allocation of certain genera now placed in Cotingidae. Although de Schauensee kept the traditional arrange-
**Ricinus miyarchii, new species**

**Type locality:** St. Anthony’s Park, Minnesota.

**Type host:** *Ricinus communis* (Linn.).

**Diagnosis:** A medium-sized species of the *Ricinus* group. Closest related to *R. sphaerocephala*. Shape of mandibles characteristic, left tip notchied. Labium with 14 pairs of setae.

**Description:** Head shape as in pl. 6, fig. 1. Mandibles as in pl. 6, fig. 2; left tip notched. Labium with 14 pairs of setae; pattern as in pl. 6, fig. 4. Setae s2 and s4 situated medially on marginal carina. Premental setae present; inner pair as long as mental setae. Gular plate as in pl. 7, fig. 2; total pattern of type 3 x 2; others usually 4 x 4, but asymmetrical combinations of 3 x 4, 5 x 3, and 5 x 4 present. Setae along asteron lappets variable in number, 5 x 8, 6 x 8 x 10; average 7 x 7; type 4 x 4. Proctal setae relatively thin with inner anterior margin indented. Thorax as in pl. 7, fig. 5. Sternal plate bearing two pairs of long setae originating from two unipinnate spots. L: 1.5-2.9 long, equal in length. Setae s2 and s1-7 (1-6 in type) spine-like, equal in length.

Terminal abdominal segments of female as in pl. 7, fig. 4. Pleurites pigmented; VIII pigmented as is fig. 4. Ventral pleural setae as given in table 4. Inner tergal setae half as long as posterior setae. Prosternal setae on tergites 1-7-11 longer than sternites 5-7. Ventral margin with 17 to 23 setae, average 22.3. Male genitalia as in pl. 7, fig. 2; one or two pairs of setae on outer margins of parameres. Moderately pigmented species; color brown with blackish white.

**Dimensions:** Total length, 3.37-2.49 (3.45); 2.61, 2.71, 2.75; type 2.25; greatest width, 0.95-1.05 (1.05); 0.88, 0.84, type 0.73; head length, 0.65-0.66 (0.67); 0.57, 0.57, type 0.57; head width, 0.63-0.66 (0.65); 0.55, 0.55, type 0.55; head index, 1.62-1.95, type 1.92; 1.9, 1.9, type 1.9; head width, 0.36-0.42 (0.42); 0.32, 0.32, type 0.32; proctolophic length, 0.32-0.38 (0.37); 0.29, 0.29, type 0.29; proctolophic width, 0.29-0.32 (0.30); 0.26, 0.26, type 0.26; distance between prosternal setae, 2.8-3.25 (3.25); 2.5, 2.5, type 2.5; distance between tergal setae, 6.8-9.5 (8.5); 6.5, 6.5, type 6.5.

**Material examined:** From *Myrchaetes simila tenax* (Hoffman) (U.S.N. 6625) collected in Jamaica, St. Vincent, Carriacou, March 1907 by M. A. Carriker, Jr. (Carriker's 1964 correction is in error). From *Myrchaetes c. escheri* (Lawrence) (U.S.N. 13143, 2 slides) collected in Arizona in March 1939 by E. Moenkhaus.

**Remarks:** Carriker has changed the hosts for *R. leptonus* twice, resulting in several contradictions and confusion. In his original description of *leptonus* (Carriker, 1933), it was described in which the type setae were two from *Myrchaetes lawrencei nigricans* and two from *Myrchaetes c. escheri* collected from St. Vincent, Carriacou, March 1907. In 1940 he stated that the male type was from *Myrchaetes simila tenax* (Giraud), but the females attributed to this species were from *Myrchaetes luteolus* nigricans. Nothing was mentioned about the other male. In 1964 Carriker stated that the *R. leptonus* type and the other two paratypes were labeled as being from *Myrchaetes simila tenax* (M. tenax escheri). The other *R.* paratype was lost. Furthermore, Carriker said that his research left him without any doubt that *R. leptonus* was from one of the Coleidae. This was closely related to *R. prometheus* from *Rhiziptera simplex*. He went on to indicate that some mistake probably was made in labeling back in 1902. In that year he made a collection in Pozo Aroz in Costa Rica where an invalid was collected. Thus he assumed that *Rhiziptera prometheus* (K. kondylylla) was the correct host of *R. leptonus*. He stated as evidence that the male genitalia of *leptonus* was very close to that of *R. polychoeropus* Carriker, also from Costa Rica.

By careful examination of the males of the *acrosticus* group, I became convinced that the genus from which *R. leptonus* was taken could be determined. The type of *R. leptonus* and the inner proventral setae as long as the mental setae, a characteristic shape of the mandibles, two pairs of large setae on the prosternal plate and tine setae on the outer margins of the parameres as well as spicle setae. Specimens from Costa Rica do not have this combination of characters. On the contrary, they resemble specimens of *R. acrosticus* from Jamaica in the following characters: shape of the mandibles; one pair of small setae on the plate in length to the posterior sternum; no lateral setae on the parameres;
and short, pilose preanal setae. In properly oriented and cleared specimens of R. aruncus, the four thumb-like process of the last mandibles are present as pictured by Carrick for R. polychoepus. These "setae" are not evident in R. leptosomus. The only available specimens that have the same combination of characters as the type of leptosomus are from Myiacarus spp. Specimens from M. crinipes (Linn.) differ from leptosomus in other respects and are described herein as R. major. The specimens from M. cinctipes are identical except for the degree of pigmentation which may or may not be an artifact. It appears that either Myiacar- 
hus tuberculifer or Myiacetes similis is the type host of R. leptosomus rather than some species of Cotingidae. It appears best to use Carrick's (1949) statement regarding the type host; until material is available for study from Myiacetes similis.

Ricinus succinaceus (Kellogg, 1894) sexes late


Diagnosis.—A small species of the succinaceus group, closely related to R. penneaticus. Prothorax hexagonal; L and Lh long, Lh short; pretergal setae less than 49a, apart. Setae a1 with two sensilla. Mt three times as long as Mt. Proventral setae spinous. No tentacle setae on female. (Chordate of ventral pleurotom as in table 4. Margin of mesosoma ending in a median, well-developed point. A lightly sclerotized species, color gold on whitish background.

Description.—Head as in pl. 8, fig. 2; Mandibles and labium as in pl. 8, figs. 3 and 4, respectively. Setae a1 each with one sensillum medially and one sensillum laterally. Proventral setae spinous. Gular plate as in pl. 8, fig. 2; chitinous setae, 4-6 in 4-6, average 5-6. Setae m4 three times as long as Mt. Setae along antennal lappets in number, 6 x 6 to 8 x 9, average 7.7. Median setae slightly longer than auxiliary setae.

Prothorax as in pl. 8, fig. 6; hexagonal; lateral protergal setae 5 and 6 long and broad. Protergal plate as in pl. 8, fig. 6; with protergal setae less than 49a, apart. Setae g1 and g2 spinous, equal in length to h1. Setae 2 and 3 of a row longer than others; 5 to 7, present in w series, average 5.6. Sternal plate characteristic as in pl. 8, fig. 6; hearing two long anterior setae and one pair of short posterior setae.

Terminal abdominal segments of female and chitinous as in pl. 8, fig. 6. One pair of medium-sized setae on tergites I-VIII; chitinous of ventral pleurotom as in table 4. Vulval margin with 8 to 14 setae, average 11.5; one pair of these lateroventral to long interna- lateral setae of sternite VIII. Male genitalia as in pl. 8, fig. 1; spined setae present but exact number cannot be determined. Proctiger margin of mesosoma ending in strong medial point. A lightly pigmented species; color gold with whitish background; nidi of head golden brown.

Dimensions.—From Empidodes spp.: Males (n = 12); total length 2.5-3.0 (2.91); greatest width 0.80-0.90 (0.85); head length 0.56-0.64 (0.59); head width 0.22-0.27 (0.24); head index 106-114 (110); labial width 0.22-0.33 (0.24); preoral length 0.28-0.36 (0.32); prothoracic width 0.48-0.53 (0.51); distance between proventral setae 21-37 (25); from Fipilo aberti: Females (n = 4); TL 2.30-3.33 (3.25); GW, 0.90-0.95 (0.90); HW, 0.53-0.57 (0.56); HI, 107-111 (110); LW, 0.22-0.27 (0.26); TL, 0.31-0.33 (0.32).
by Carriker (1964) to differentiate this species are considered to be artifacts. R. sublittoralis is designated a junior subjective synonym of R. succineus (Kellogg).

**Ricinus pessimalis** Eichler, 1964


**Diagnosis.**—R. pessimalis is the smallest species of the genus. Closely related to *R. succineus*. Prothorax subequal in length to mesothorax. Prothorax plate pointed laterally. Prothorax plate spinose. Setae 5a equal in size to size of 2a. Setae are setae equal in number, 5-3.5 to 6.5, average 5.7.

**Prothorax subequal:** prothorax plate as in pl. 9, fig. 4; anterior prothorax setae more than 40a; postero-lateral setae 5a, 6a, 7a, and 8a, 9a, 10a, 11a, long, short. Five setae usually present as in seta; 2 a larger than 1a; 3 smaller equal than 2a. Setae 5a and 6a, 7a and 8a, 9a and 10a, 11a, long, short. Setae 5a shorter than 1a; 6a, 7a and 8a, 9a, 10a, 11a, short. Setae are usually present on a line; 5a, 6a, 7a, and 8a, 9a, 10a, 11a, short. Setae size usually present as in seta; 1a larger than 2a; 3a smaller equal than 2a. Setae 6a, 7a, and 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short. Setae 6a shorter than 1a; 7a, 8a, 9a, 10a, 11a, short.
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Description.—Head as in pl. 10, fig. 1. Mandibles dimorphic, as in pl. 10, fig. 3. Labium with 15 pairs of setae, as in pl. 10, fig. 2. Maxillary plate muscle-shaped, relatively wide; characteristically pigmented pattern. Maxillary palp straight, extending past edge of head. Mandibles with characteristic pigmented pattern, not lunate-shaped. Setae ml-ml subequal; ml-1 lateral usually; ml half as long as pm series. Marginal carinae with set insertion of ml and ml2 between and both between and m3. Ovoid sclerite round and compact; anterior corna bearing a plumose-like structure. Lateral coil absent. Gular plate in pl. 10, fig. 1; galea seta in females number 2 to 4 or 6 or average 4.3 to 4.8; in males 2 to 4 to 6.6; average 4.2 to 6.3. Setae along antennal joints variable in number; in females 6 to 7 to 9 to 13, average 6.8 to 6.6; males 5 to 7 to 9 to 9, average 7.1 to 7.1. Setae pol novantly as long as tl; pol spine length variable; pol variable. Temples expanded, not tapering greatly, spicules hooked.

<table>
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<th>Character</th>
<th>Juveniles</th>
<th>Adults</th>
<th>Amphipods</th>
<th>Zonulaeformes</th>
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<th>Meliponinae</th>
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<td>Distance of prosternum</td>
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<td>12-16</td>
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</table>

Protermes as in pl. 10, fig. 5. Setae L7 and L8 long; L9 pils, about equal to m4; L3 longer than L4; L5 longer than L6. Protermes plate as in pl. 10, fig. 5, and pl. 9, fig. 9; bearing a pair of long setae, longer than posterior pair. Cove, trochanters, and femora of legs II and III each with one tactile setae.

Terminal segments of female abdomen as in pl. 10, fig. 4. Antenna slightly ovate. Pleurites pigmented to margin; color brown. Setae of ventral pleurites as given in table 4. Both pairs of tergal setae long on tergites II-VII; outer setae long on tergite VIII. Sternopleural and sternocentral setae long, equally spaced on sternites II-VII; close together on sternite VII. Tergites without; sternites light gold in color. Vulva with four tiny setae. Terminal segment of female with three pairs of long setae. Four or five pairs of setae on sides of anterior anal corona. Male genitalia as in pl. 9, fig. 7. Parameres rounded, without setae. Margin of mesosome entire.

Dimensions.—See tables 7 and 8.
TABLE 8

Mean and Range of Measurements of Males of Reticula frigidae Populations

<table>
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<th>Mean</th>
<th>Range</th>
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<td>Greatest width</td>
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<td>Head index</td>
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<td>Prothoracic length</td>
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<td>Prothoracic width</td>
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</tr>
<tr>
<td>Distance between prosternal</td>
<td>15a</td>
<td>10a</td>
</tr>
</tbody>
</table>

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P. bowyckillae Denny and found them to be indistinguishable from R. fringillae DeGeer; thus bowyckillae is a junior objective synonym of R. fringillae. In retrospect it appears that Denny’s specimen from Bombycilla garrulus may have come from Emberiza nivula, a known host of R. fringillae, thus accounting for the smaller size of Denny’s specimens. R. fringillae DeGeer is not known to occur on Bombycilla garrulus. The status of the population from this bird species is discussed under B. elongatus (Offera).

R. pallidus (Kellogg, 1896) and R. hastatus (Osborn, 1902) are synonyms of R. fringillae. R. hastatus is also a junior objective synonym of R. pallidus. No leototype has been designated for Phylloscopus diffusus var. pallidus, Kellogg, 1896. Carriker (1957) mentioned three females on one slide, but did not designate one of them as leototype. The lectotype is herein designated as the female remounted on the original slide with the original label. The other female and nymph—not a third female as indicated by Carricker (1957)—are remounted on another slide and labeled paralectotypes. I am puzzled as to why Kellogg (1896) included pallidus as a variety of diffusus, since R. diffusus and the form pallidus do not resemble each other. Although no specimens referable to R. diffusus from Junco sp. are present in the Kellogg collection, specimens of typical diffusus taken from Junco sp. are present in the USNM collections. Eaton (1909) designated lectotype for Phylloscopus hastatus Osborn, 1902, from Junco aikeni. He mentioned that Osborn’s other two specimens were missing. They have been found in the collections of the Ohio State University and are labeled paralectotypes.

The R. fringillae complex is one of the most interesting and most confusing complexes in R. fringillae. Most populations, occurring on three families of passerines, are very similar morphologically. Within the complex are populations that differ in size alone or in degree of pigmentation. In all these populations the shape of the mandible, prothorax, female terminalia, and male genitalia are identical, varying only in overall size. Populations from Ammodramus sp., Junco sp., Melospiza melodia, Passerella iliaca, Passerculus sandwichensis, Spizella sp., and Zonotrichia sp. are also identical in chaetotaxy and fall within the same size limits. It is impossible to separate specimens collected from these hosts.

Two populations of R. fringillae from Pipilo fuscus and Passerina hyperborea (now Phylloscopus hyperborea) are identical in shape, chaetotaxy, and other morphological characteristics. However, these populations are significantly different statistically in over-all size. The one specimen from P. hyperborea is heavily pigmented. I am reluctant to describe and name a new species based on one specimen and two characters that are subject to variation through curatorial procedures. This population is referred to Phylloscopus fuscus sensu lato. The specimens from P. fuscus are overloaded to the extent that pigmentation patterns appear to have been altered, but the shape of structures seems unaffected. A single specimen from Pipilo erythrophthalmus falls within the size range of R. fringillae from Junco sp., whereas the type population from P. fuscus is much larger than R. fringillae sensu stricto. In R. fringillae the over-all size difference without accompanying morphological differences does not appear to be a character of specific value. At present it is not known whether size difference has a genetic or an environmental basis. It appears best, in the absence of distinguishing morphological characters, to regard this population as R. fringillae sensu lato.
Specimens from *Passer domesticus* (probably a thrush) and *Parus atricapillus* are also similar in size, shape, and chaetotaxy to *R. fringillae*. The latter population from *Passer* sp. was described as a new species, *R. mediola*, by Uchida (1925). The only apparent difference between *mediola* and *fringillae* is the pigmentation pattern. The carinae and nodi are black as opposed to brown or golden brown in *fringillae*. The pattern on the sternites appears to differ from *fringillae*, but clearing may have altered this pattern in *mediola*. Overlaid specimens of *mediola* differ in no respect from the cleared specimens of *fringillae*. Therefore, the only data that indicate that *mediola* should be separated from *fringillae* are the differences in degree of pigmentation and the host association. The population called *mediola* occurs on hosts of the family Paridae, which is not closely related to Fringillidae. In my opinion these differences are not of species stature. In other species of *Ricinus*, changes in pigmentation pattern also have been accompanied by differentiation in other characters. *R. mediola* Uchida is considered to be a junior subjective synonym of *R. fringillae* DeGeer by Rheinwald (1968) and myself.

Two populations appear to be different in size, coloration pattern, and several morphological features. These are referable to *R. microcephalus* (Kellogg) and *R. japonicus* (Uchida). Although these populations are similar to *fringillae* in several characters that Uchida and Hopkins (1951, 1954, 1960) indicated had specific value in *Ricinus*, they differ from *fringillae* in shape of head, setation of labium, and pigmentation pattern. These characters also were said to have specific value by Clay and Hopkins. Because several characters are available to separate these populations from *fringillae*, I consider *R. japonicus* (Uchida) and *R. microcephalus* (Kellogg) as good species. The former species is found on hosts in the family Motopeidae, whereas the latter's host species is a member of the family Fringillidae, subfamily Carduelinae. Rheinwald (1968) considered these species as synonyms of *R. fringillae*.

**Ricinus japonicus** (Uchida, 1915)


Diagnostics.—A medium-sized species of the *fringillae* species group. Closely related to but in separable from *R. fringillae* in characters of mandibles, prothorax, and male genitalia. Differ in other characters. Shape of head characteristic, longer than in *fringillae*. Temple narrow, tapering gently from eye to spine, ending in acute angle, barely hooked. Labium with 16 pairs of setae. Shape of palpotax characteristic. Marginal carinae wide between marginal and 1st lateral at 0.25. Inner margin of carinae anterior to mL. Narrow and straight for short distance then hooking medial and slightly posterior where margin becomes diffuse or absent, appearing to be fused with tergal suture. Q present. Pigmentation of abdomen characteristic; color golden-brown. Posterior margin of pleurae, tergites II-VII, and sternites III-VIII unpigmented. Unpigmented areas around bases of tergals and sternals on these segments.

Description.—Head elongated, as in pl. 11, fig. 1. Mandibles similar to those of *R. fringillae*, but
and figured a neotype for R. elongatus. They placed ernstlangi into synonymy and further indicated that mystax also may be a synonym of elongatus. Zlotoryzka (1965) thought that the three names (elongatus, mystax, and ernstlangi) apply to three distinct species, but she failed to give conclusive support for her contentions.

According to Rheinwald (1968), R. elongatus taken in the Old World from Bombicilla garrulus were similar to populations from Turdus spp. My examinations of specimens from these hosts collected in both hemispheres lead me to agree. No differences in chaetotaxy, pigmentation pattern, or shape of structures exist between populations from Turdus spp. and B. garrulus. The differences in the dimensions of the head and abdomen given in table 9 are considered to have resulted from overcleaning. Ten of fifteen specimens from B. garrulus were overcleaned. Statistically the two populations are separable at the subspecific level based on differences in total length. This alone, however, is insufficient to separate these populations into different species. Specimens from B. garrulus are referred to as R. elongatus. Since the name bombicillae is referable to R. fringilla (see remarks under this species), the next name available for the population is R. intermedius (Pigott, 1890; see Uehida, 1915). This name is designated as a junior subjective synonym of R. elongatus (Olfers, 1816).

Ricinus mandibulatus Species Group

**Diagnostic Characteristics**

1. Mandibular tips monomorphic; mandibular lobes dimorphic left lobe with small knoblike extension articulating with right lobe.
2. Head rounded in shape; from torment with parallel margins; margin of head slightly concave; opercular margin concave; opercular nodus bicconcave.
3. Ovoid scutellum evident.
4. Tergites well developed; humer nodd present.
5. Maxillary palpi 4-segmented.
6. Setae on tibia with 2 setula; 3 seta absent.
7. Prothorax hexagonal.
8. Pronotum spinose.
10. Head attaches to prothorax by two broad lobulate articulations.

**Remarks.** The mandibulatus species group is represented by one species, R. mandibulatus. This species appears to represent a link between the species of Ricinus with dimorphic mandibles and the marginalis species group. But for the dimorphic lobes of the mandibles, inclusion in the marginalis species group is suggested.

**Ricinus mandibulatus**, new species

| Type locality: Choluteca, San Francisco, Honduras. Type host: Campsis papillosa (Baird). Diagnosis.—A species of the mandibulatus species group. Shape of head and thorax resembles R. marginalis. Mandibles with large tips; mandibular lobes dimorphic. Labium with 14 pairs of setae. First segment of maxillary palpi bearing a large spine. Shape of prosternal and sternum plates as in pl. 14, fig. 3. Pleures pink to maroon. L3 almost. Description.—Shape of head as in pl. 14, fig. 1, resembling that of R. marginalis except for shape of opercular nodus. Frasal trunks, transverse carina straight; frontal incisions fused with transverse carina. Mandibles with large monomorphic tips; mandibular lobes dimorphic; knoblike extension of left mandible small, as in pl. 14, fig. 3. Labium with 14 pairs of setae, pattern as in pl. 14, fig. 2. Setae on marginal carinae; mm three times as long as pr setae.
**Ricinus inexactus Species Group**

**DIAGNOSTIC CHARACTERISTICS**

1. Narrow conical head; margin of from continuous with margin of marginal carinae.
2. Tips of mandibles essentially monomorphic; left mandible lobe with small tooth-like articulation.
3. Oil vesicles not evident.
4. Maxillary plates sausage-shaped; palpi gastricoid.
5. Pleurites pigmented; sacci black in auriculate species group.
6. Lanar, translar, and antennal sacci present.
7. Setae 8 absent.
8. Chaetotaxy of ventral pleurites as in table 4.
9. Preocular setae large, rounded structure with large stoma.

**Remarks:** The *Ricinus inexactus* species group is represented by a single species, *R. inexactus*. The shape of mandibles shows an intermediate condition between the forms having dimorphic mandibles and those having monomorphic mandibles. This species also shares many structures that are characteristic of other species groups; thus it cannot be adequately placed in any of these groups. Its uniqueness warrants the recognition of a separate species group. The specimen of *Ricinus* erroneously called *R. alphonseii* by Carrière (1964) is referable to this group (see discussion under *species inquirenda section*).

**Ricinus inexactus** (Kellogg, 1899)


**Diagnosis:** A small species with characters of the *inexactus* species group. Head narrow and conical with lanar sacci present. Mandibles monomorphic; maxillary lobes lobes dissimilar, rotation of maxillary plate characteristic, anterior and posterior pairs of setae equal in length, shorter than middle pair. Pronotum subcylindrical, anterior and pleural carinae thick. Tergal setae long, outer pair of apical setae on parameral teles as long as inner pair.

**Description:** Head as in pl. 15, fig. 1; from transversale carina pigmented, fused with frontal incision. Mandibles as in pl. 15, fig. 3. Labium with 12 pairs of setae, pattern as in pl. 15, fig. 3. Maxillary plates sausage-shaped; maxillary setae longer than mesosomal. Maxillary palpi not reaching to margin of head, gastricaloid; first segment with spine on setae and microsetae on anterior distal margin. Setae m4 and m6 series short and equal in length, about three times as long as m4–m6. Setae 1s short, each with two widely spaced sacci; 8s absent. Gular plate as in pl. 15, fig. 4; anterior and posterior pairs of setae medium in length, middle pairs long; pattern 3 x 3 usually, 3 x 3 (2), 4 x 4 (1). Number of setae along antennal appendages variable, 4 x 9 x 9 x 4, average 7 x 5.

**Ricinus inexactus** as in pl. 15, fig. 6; setae L7-8 long, L9 short. Prosternal plate as in pl. 15, fig. 6. A large spinose setae on outer margin of pronoxa. Two tactile setae on femur I. Sternal plate wide medially as in pl. 15, fig. 6; bearing two pairs of long setae and one posterior pair medium in length. Five or six spinose setae in s setae; 4 or 5 as long as x1, 2 and 4 or 5 as long as x2. Setae q2 spinose. Setae c1 spinose, short, slightly longer than pharallic; c1 and c4 medium-sized and equal in length. Phragmines III Weakly pigmented, Cens 12 and fusion II and III each with one tactile seta. Crown setae of tibias I-II with two strongly spinose setae.

Terminal segments of abdomen of female as in pl. 15, fig. 5. Pleurites pigmented to margin; color brown. Nodid thick. Chaetotaxy of ventral pleurites as given in table 4. Medium-sized setae on sternites 2–VI. Tergal chaetotaxy unique; inner and outer tergal setae of T5–VI long; outer setae of VIII short; inner setae medium in length. Ventril margin with six to ten setae. Sternites VI–VIII lightly pigmented, color in 1, males sterile setae of sternite IX close together. Male genitalia as in pl. 15, fig. 4; margin of monosomes ending in a strong point. Precopulatory gland large and rounded with large stoma. Two pairs of spinal setae on parameres; outer pair twice as long as inner pair. Moderately sclerotized species, pleurites and nodi brown; golden background.

**Dimensions:** From *Chromis iracunda* iracunda (Nélson): Males (n=20): total length 0.22–0.49 (0.35); greatest width 0.09–0.24 (0.17); length of antennae 0.09–0.24 (0.17); head index 108–118 (118); lateral width 0.22–0.27 (0.24); pronotal length 0.29–0.32 (0.30); prothoracic width 0.49–0.52 (0.50); distance between prothorax (n=2) 72b, 72c; width of genitalia 0.16–0.17 (0.16). Females (n=2): TL 335, 344; GW 0.64; 0.64; HL 0.66, 0.66; HW 0.66; 0.66; HI 109, 112; LW 0.64, 0.64; PW 0.58, 0.58; distance between prothorax 58b. From *Machadoreus regalis*: female (n=2): TL 28.1, 28.1; GW 0.74; HL 0.64; PW 0.58, 0.58; distance between prothorax 58b.

**Distribution:** Known to occur on three genera in the family Pipridae.

**Material examined:** From *Chromis iracunda* (Wagner) borealis and *f* and *f* and *l* paratypes (VLK 1406) from Panama in September 1895 by R.C. McClellan. From *Machadorus regalis* (VLK 1406) from Panama in September 1895 by R.C. McClellan. From *Machadorus regalis* (VLK 1406) from Panama in September 1895 by R.C. McClellan. From *Machadorus regalis* (VLK 1406) from Panama in September 1895 by R.C. McClellan.
Remarks.—Kellogg (1899) described Physostomum inquadrata from Chrisophora lanceolata et Malaneprepus tegulatus. Carrick (1957) designated a male specimen collected from C. lanceolata as the lectotype. This is now mounted on a separate slide and labeled properly. Two paratypes are remounted on another slide. Carrick thought that the specimen from M. tegulatus was a strongerl, and removed the specimen from the host list. I fully agree with this action.

I have been unable to separate the type of Ricinopsis expediens Eichler, 1954. The figure of the head agrees completely with that of R. inquadrata and Eichler's R. expeditiens. Eichler designated a junior subjective synonym of R. inquadrata (Kellogg). The two subspecies, R. m. macheropetra and R. m. subrufidus, described by Carrick (1964), are similar to R. inquadrata and are designated as junior subjective synonyms of this species.

Ricinus serratus Species Group

Diagnostic Characteristics

1. Head conical, with distinct postfrontal constriction; broader than long.
2. Clypeal carinae fused transversely frontal carina forming an arch.
3. Mandibular tip heavy; membranous.
4. Ovoid setae appear to be fused medially; heavily ornamented.
5. Palpiites each with two setae.
6. Setae along antennal lappet reduced, five or less, usually two or three pairs.
7. Dorsal plate without posterior extensions; truncate behind.
10. Prechelal plate without adnotal nodi; prochelal setae close together.
11. Setae q:4:large and spinose.
12. Setae sculpturing on anterior margin of prothorax, on lateral margins of prothorax along phragmum II and I and V setae.
13. Pleural nodi unique, with undulating margins; oriented medially.
14. Mesosoma v-shaped, ending medially in a long produced point.

Ricinus serratus (Durrant, 1900)

Physostomum serratum Durrant, 1900d. Ohio Nat. 6:528, fig. 11; Kellogg, 1908, Wynn's Gen. Entomol. 66:72, fig. 1; Type host: "Dutch Horned Lark," Otolaror sp. (now Prosopus abbreviata durranti (Beauvois)).

Physostomum ophelanto Mjoberg, 1910; Ark. Zool. 6:60, figs. 35-36, pl. 8, fig. 1; Type locality: Hampton, Co., Oklahoma. Type host: Ads in cinema. Type host: Ads in cinema. Type host: Ads in cinema. Type host: Ads in cinema.

Eicenops ophelanto (Mjoberg), 1910; Ark. Zool. 6:60, figs. 35-36, pl. 8, fig. 1; Type locality: Hampton, Co., Oklahoma. Type host: Ads in cinema.

Eicenops serratus (Durrant), 1916; Parasit. 9:66; Hakor, 1910, Rept. Canad. Arctic Exped. 3:18; Seguy, 1944, Faune de France 14:137.


Diagnosis.—A large species with characters of the ricinus species group. Easily distinguished from all other Ricinus by shape of head, shape of prothorax, shape of gular and posterior...
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3. Head conical, elongated; from usually truncate, sides parallel; margin of front not continuous with margin of head; sides of head slightly concave; occipital margin concealing, except in R. marginatus.


5. Maxillary palpi pectinately-toothed; plate smooth-scaled.

6. Seta s 1 each with two sensillae; a 3 absent.


8. Progenital sternum.


11. Preputial sacs rounded, with large stoma.

12. Margin of mesosome variable, entire or with a blunt to sharp median point; parameres pointed, bearing apical setae.

13. Pattern on terminal tergite of female, 1/2 x 1/2.

14. Setae c 3 and c 4 present.

15. Lunar nodi present.

16. Ventrianal wall poorly developed; posterior pits well developed in E. marginatus, weak or absent in R. scenus.

Ricinus farinaceus Carriker, 1964


Diagnosis.—A small species of the marginatus species group. Mandibles with large needle-like tips. Frons truncate, rounded laterally. Lunar nodi diffuse. Occipital nodus bicuneate; median margin extending to edge of dorsal occipital margin. Temple spines blunt, not hooked. Gular plate characteristic. Setae s 1 each with two sensillae; anterior pair separated from s 1 by distance of diameter of smallium; posterior sensilla widely separated, in line with setae m 3. Pleurostigmata pigmented to margin. Both pairs of tergal setae present on tergite VIII. Known only from type specimen.

Description.—Head as in pl. 17, fig. 1. Frons truncate, rounded laterally; frontal carinae wide. Transverse carinae wide, fused together with frontal incisures. Mandibles as in pl. 17, fig. 3. Labium obliterated in holotype. Maxillary palpi geniculate. Lunar nodi diffuse. Setae s 1 each with two sensillae; anterior sensillum separated from s 1 by distance of diameter of smallium; posterior sensillum widely separated, in line with setae m 3. Setae m 3 each, small, slightly smaller than pa setae. Setae p 3 slightly larger than p 1 and p 2. Gular plate as in pl. 17, fig. 1, setae 2 x 2.

Ricinus horridus Carriker, 1964


Diagnosis.—A large species of the marginatus species group; populations herein retain the greatest size in Ricinus. Shape of head characteristic: frons truncate, Mandibles characteristic, tips arched. Transverse carinae wide, fused with frontal incisures. Transverse carinae extending along margins of front. Mandibles as in pl. 18, fig. 2, tips arched. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.

Description.—Head as in pl. 18, fig. 1. Frons truncate. Transverse carinae fused laterally with frontal incisures. Frontal carinae extending along margins of front. Mandibles as in pl. 18, fig. 2, tips arched. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.

Ricinus similis Carriker, 1964


Diagnosis.—A species of the marginatus species group; populations herein retain the greatest size in Ricinus. Shape of head characteristic: frons truncate. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.

Description.—Head as in pl. 18, fig. 1. Frons truncate. Transverse carinae fused laterally with frontal incisures. Frontal carinae extending along margins of front. Mandibles as in pl. 18, fig. 2, tips arched. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.

Ricinus bellus Carriker, 1964


Diagnosis.—A species of the marginatus species group; populations herein retain the greatest size in Ricinus. Shape of head characteristic: frons truncate. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.

Description.—Head as in pl. 18, fig. 1. Frons truncate. Transverse carinae fused laterally with frontal incisures. Frontal carinae extending along margins of front. Mandibles as in pl. 18, fig. 2, tips arched. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.

Ricinus bellus Carriker, 1964


Diagnosis.—A species of the marginatus species group; populations herein retain the greatest size in Ricinus. Shape of head characteristic: frons truncate. Labium with 14 pairs of setae, as in pl. 18, fig. 5. Setae m 3 along inner margin of marginal carina. Maxillary plate smooth-scaled; palpi geniculate, not extending to margin of head. Transverse carinae small, half as large as inner nodi. Pronotalia spinose. Setae n 1 with two sensillae; a 3 absent. Setae p 3 slightly longer than p 1 and p 2. Setae p 1 present. Temple expanded, apically pointed, to prothorax. Dorsal occipital nodus bicuneate, median margin posterior to occipital margin. One pair of tergals on tergite VI. Prophallic sac irregular in shape, with atoll-like structure. Pleural nodus pigmented; pleurostigmata not pigmented.
**Table 10 (Continued)**

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<tr>
<th>Character</th>
<th>Tyrannus perplexus n = 11</th>
<th>Tyrannus talarnus n = 6</th>
<th>Tyrannus maritimus n = 4</th>
<th>Maximum n = 1</th>
<th>Stragglers n = 1</th>
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**Table 11**

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<tr>
<th>Character</th>
<th>Tyrannus perplexus n = 11</th>
<th>Tyrannus talarnus n = 6</th>
<th>Tyrannus maritimus n = 4</th>
<th>Maximum n = 1</th>
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**Table 10**

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<th>Character</th>
<th>Mean and Range of Measurements of Females of R. marginatus Populations</th>
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**Table 11**

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<th>Character</th>
<th>Mean and Range of Measurements of Males of R. marginatus Populations</th>
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</tr>
<tr>
<td>Width of c gennalis</td>
<td>0.24</td>
</tr>
</tbody>
</table>

For more details, please refer to the original source or consult the references provided.
Nelson: Revision of the New World Species of Ricinus

As no consistent criteria are available to separate these populations, I have included them under the name R. marginatus sensu lato as suggested by Clay (1962). Unfortunately, owing to this action a long-established name, R. angustifolius (Kellogg, 1839), becomes a junior subjective synonym. Except for workers in Mallophaga, the singling of angustifolius poses no problems, as the name has not been used excessively. I am reluctant to ask the International Commission to invalidate angustifolius. Future work may reveal biological differences that warrant separation of populations now in marginatus to specific status. R. angustifolius could then be restored for the population on Typha, Muscium, and Pterophyllum. Ifmarginatus is invalidated, the separation of populations would leave the population from Empidion sp. without a name.

Ricinus freudus (Burmester, 1838)


Description—Head as in pl. 19, fig. 1; sides of frons parallel, margin rounded; temples short and triangular. Mandibles as in pl. 19, fig. 2; anterior lobes reduced. Labium with 14 pairs of setae; pattern as in pl. 19, fig. 2: Maxillary plates smooth-shaped; palpi pectinate. Ovipositor present in stained specimens, unremarkable. Setae a4 and larger than pa series, but not twice as long; a2 on marginal segment. Setae a3 slightly longer than a4 and a2. Setae a2 to three times as long as a4; each with two setules; a3 anterior widely separated from a2, near anterior tubercular pit; posterior pair proximate; a6 and a7 absent. Gular plate as in pl. 19, fig. 1; setae present; three along notumal lappets well spaced, 3 vs. Tertial setae as large as larval ovi.

Posterior hexazonal, as in pl. 19, fig. 4; 5 larger than Lers and 16o; 17 and 4 low, L8 not centrally placed along the posterior margin. Cus a2 with two tactile setae; feuves I with three tactile setae. W series with six setae. Setae a2 strongly spinose, setae a4 twice as long as a3. Verruca spiculate as in pl. 19, fig. 4, bearing two pairs of long setae and one pair of short posterior setae. Cus a1 and feuves 1 and 2 each with one tactile seta.

Pleurites not pigmented to margin; chaetotaxy of ventral pleurites as given in table 4. Vagina without setae except for long subteral setae. Male genitalia as in pl. 19, fig. 6. Margin of mesosomal ending in a blunt point. Parastome setae; atrichores each with three setae. Male red brown.
Ricinus polytropus Carriker, 1961


Diagnosis.—A medium-sized species of the margaritifera species group. Related to R. frentas. Shape of head characteristic; free transverse; head long; ratio with both temples long and narrow. Mandibles with long needle-like tips. Labium with 12 pairs of setae. Gular plate long and pointed. W serial with seven setae. Setae a1 short. Plaun leaves to margin. Prothorax subcordate. Prothorax.—Head as in pl. 20, fig. 1; from transverse; temples long and thin. Mandibles as in pl. 20, fig. 2; with long needle-like tips. Labium as 12 pairs of setae, pattern as in pl. 20, fig. 2. Setae a1 twice as long as an; s2; off marginal carina. Setae a1 short, each with two sensilla; posterior scutellum near a2; a3 and a4 absent. Setae a2 twice as long as po and pol. Gular plate as in pl. 20, fig. 1; setae 2, 2. Seven pairs of setae along anterior hystps. Tectoral noda lower than later nodi.

Prothorax subcordate, resembles that of R. scapulifera in pl. 20, fig. 3. Larger than L. 7th-8th situated medially on prothoracic margin; L. 9th short. Seven setae in W series; s2; broken in the type. Setae c1 spine, twice as long as c2; c4 longer than c2, both plate.

R. guianensis and R. polytropus in a series; c1 not twice the size of w2. Setae q2 long and spine. Setae c4 slightly longer than c3. Gular plate as in pl. 21, fig. 8; posterior setae short. A short tectoral noda on tarsus IV.

Terminal segments of female abdomen as in pl. 20, fig. 2. Plaun leaves to margin. Color blackish. Manacles of ventral plaeurus as given in table 4. Vulva with four setae. Noduli colubro; carinae and markings on sternites YI and YII gold; background white.

Male unknown.

Dimensions.—Type specimen: total length 6.22; greatest width 1.01; head length 0.83; head width 0.73; head index 114; labral width 0.35; prothoracic length 0.34; prothoracic width 0.67; distance between prothorax 6.2.

Distribution.—Known only from Polypterus plabiatus, family Beryllinae. Possibly occurs on the two species of Polyipterus in North America.

Material examined.—From Polypterus plabiatus plabiatus Lawrence; holotype 9 (USNM 53757) from Villa Velas Matz, N., Colombia, on 10 May 1947 by M. A. Carriker, Jr. From P. plabiatus immaculatus 3 (USNM 85768, holotype of R. guianensis Currier) from Bolivar, Venezuela, La Balsa, on 14 April 1968 by M. A. Carriker, Jr.

Remarks.—R. guianensis Carriker is considered a junior objective synonym of R. polytropus Carriker. This type of guianensis is shriveled and distorted, but appears to be similar in size and shape to polytropus. No record of two different species of Ricinus occurring on two different subpecies of the same species of host.

Ricinus pallenae (Kollog, 1839)

Physostomum pallenae Kollog, 1839. Zool. Phytoph., 1: 149-149, pl. 4, fig. 7; Carriker, 1964, Mem. Nat. Mus. Geol. 21: 114-114, fig. 6. Type locality: Panama. Type host: Rhinodactylus (Doddert) and Staphylocnemus (Kollog).

Material examined.—From Phisostomum pallenae (Doddert) and Staphylocnemus (Kollog) from the Panama Province of Panama. 21-114 (1968) (M. A. Carriker, Jr.); from Staphylocnemus (Kollog) from the Panama Province of Panama. 21-114 (1968) (M. A. Carriker, Jr.)

Remarks.—R. pallenae Carriker is considered a junior objective synonym of R. polytropus Carriker. The type of pallenae is shriveled and distorted, but appears to be similar in size and shape to polytropus. No record of two different species of Ricinus occurring on two different subpecies of the same species of host.
pigmated to margin; color ochreous. Sterites VI-VII with oval markings. Setae with median blunt point. Parameres stout, each with two or three spiral setae.

**Diagnosis.**—Head shape as in pl. 23, fig. 1; from narrow, with slightly pigmented transverse carina. Mandibles as in pl. 25, fig. 3. Labium with 14 pairs of setae; pattern as in pl. 23, fig. 2. Setae 4, 5, and 6 as ps setae. Maxillary plate narrow, postocular; palpi Briettioid. Labial and central anterolateral area in ps setae, 1; number of setae 2 and 3. Setae along anterolateral lappet variable in number, 4-5 to 7 and 9, average 6.5-6.8. Setae 5 III, and with two sensillae; one sensillum usually widely separated from 5 III; 3.5 and 3.5 nearly equal. Ps setae nearly equal in size.

**TABLE 12**

<table>
<thead>
<tr>
<th>Character</th>
<th>Veronica 4 species</th>
<th>Veronica 5 species</th>
<th>Veronica 5 species</th>
<th>Veronica 6 species</th>
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<td>2.81</td>
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<td>2.77-2.80</td>
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<td>2.77-2.80</td>
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<td>0.50-0.54</td>
<td>0.50-0.54</td>
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<td>0.24-0.26</td>
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<td>0.45-0.46</td>
<td>0.45-0.46</td>
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</tr>
</tbody>
</table>

**Prethorax as in pl. 23, fig. 6; L1-L3 equal in size; L1-L3 long; L1 small. Femur I and coxa II with two long setal tufts. Setae in w species; w species III strongly spinose. Setae 5 III strongly spinose. Prothorax as in pl. 23, fig. 6. C4 longer than c5. Femur III and coxa II with one setal tuft.**

Terminal segments of female abdomen as in pl. 23, fig. 5. Pleurites pigmented to margin; color ochreous. Setae of central proventricular plate as in table 4. Vulva with 0 to 6 setae. Average 3.5. Male genitalia as in pl. 23, fig. 4. Mesosome with median blunt point. Parameres stout, each with two or three spiral setae. Nodi pigmented, ochreous; background whitish. Two galeoles on sternites VI and VII.

**Dimensions.**—See table 12.

**Distribution.**—Known from two genera, Fornix and Parasitus, family Parmidae.

**Material examined.**—From Fornix punctatus (Say): holotype 2 (USNM 60229); 2 syntypes from Lincoln, Nebraska, on 25 and 30 April 1901 by J. C. Cross, Jr., and A. A. Remm. Jr., 1 2, 2 (USNM 60229) from Post Falls Field Station, Mendocino Co., California, on 25 April 1901 by R. C. Nelson and V. D. Eichman; 1 2 (USNM 60229) from Clover Creek, Tulee Co., Utah, on 13 September 1901 by J. Busman. From study slides of F. punctatus collected by Mercedes Fabricius; 1, 2, 2, and 1 June 1899 by W. H. Osgood; 2 (USNM 60229) from North Dakota, 1 2, 2, 2, 2, and 2 (USNM 60229) from Clover Creek, Tulee Co., Utah, on 16 and 19 May 1898.

**Notes.**—Revision of the New World Species of Ricinus.
Ricinus emersoni, new species

Type locality: Miami, Florida.

Type host: *Wlanaeus camnusis* (Linnaeus).

Diagnosis: A small species from the family Papilionidae. Closely related to *R. pictus*. Mandibles characteristic; tips short and thick. Shape of head characteristic, from wide. Less than eight setae along each antennal lappet. W and q not strongly spinose. Color of both with no pigmentation on sternites. Mesosternite with small median knoblike extension. Parameres narrow; apex each with three setae, outermost slightly larger than inner setae. Gular plate short and wide; anterior part slightly swollen. C4 much longer than C1.

Description: Head shape as in pl. 24, fig. 1; from wide. Mandibles as in pl. 24, fig. 3. Labium with 14 pairs of setae, pattern as in pl. 24, fig. 2. Maxillary incisors fused with transverse carina. Setae 3r longer than 3a series. Maxillary plates smooth-sloped; palpi geniculated. Setae 1 and 2 each with two sensillae, anterior and posterior pair equidistant from 1a; 2a absent. Gular plate as in pl. 24, fig. 1; number of setae 1 x 1 x 5 x 2; average 1.9 x 1.6. Setae along antenntal lappets widely spaced; 4 x 4 x 6 x 6; average 6.4 x 6.4. Po series all nearly equal in size.

Proxemus as in pl. 24, fig. 5; L7 and L8 long; Df thin. Femur 1 and 2 with two long tactile setae. Usually six setae a x series (21), five setae (3) not strongly spinose. Setae q not strongly spinose. Setae 1 and 2, twice as large as c; c4 pilose, more than twice as long as c3. Sternal plate as in pl. 24, fig. 5.

Terminal segments of female abdomen as in pl. 24, fig. 6. Pleurae pigmented to margin; color of both. Chaetotaxy of ventral pleurae as given in table 4. Ventrual with 2 to 6 setae, average 3.8. Stermites not pigmented. Male gonad as in pl. 24, fig. 4. Mesosternite with median knoblike extension. Parameres narrow; apex each with three setae, outermost slightly larger than inner setae. Nodi and incisures cabled with whitish background.

Dimensions—From *Wlanaeus camnusis*; females (n = 17): total length 2.89-2.90 (2.90); greatest width 0.71-0.80 (0.75); head width 0.63-0.66 (0.63); head length 0.55-0.68 (0.68); head index 111-113 (113); labial width 0.29-0.30 (0.29); proboscis length 0.28-0.31 (0.29); proboscis width 0.46-0.49 (0.46); distance between proxemal 40-60 (50a); Male (n = 4): Tl, 2.65-2.73 (2.70); GW, 0.64-0.69 (0.67); HL, 0.46-0.58 (0.57); HW, 0.69-0.82 (0.82); HI, 1.31-1.41 (1.31); LW, 0.24-0.27 (0.26); Pl, 0.25-0.27 (0.25); FW, 0.41-0.43 (0.43); distance between proxemal 40-45a; width of genitalia 0.16-0.18 (0.17). From *Opicerpis lobata* (n = 2): TL, 2.74, 2.75; GW, 0.71; HL, 0.77; HW, 0.57; HI, 1.14, LW; 0.27; PT, 0.28; FW, 0.45; distance between proxemal 45b; width of genitalia 0.18.

Distribution—Known from *Wlanaeus camnusis* and *Opicerpis lobata*, family Papilionidae.

Material examined.—From *Wlanaeus camnusis* (Linnaeus): holotype 1, allotype 2 (both on same slide), and 2 paratypes (BCN 705) from Miami, Florida; on 2 June 1970 by J. A. Weber. 2, 2, 9, 5 paratypes (BCN 702) with same data collected on 18 May 1954; 3 paratypes (BCN 714) with same data collected on 29 May 1958; 1, 2, 2 paratypes (USNM).

Nelson: Revision of the New World Species of Ricinus


Remarks.—*Ricinus emersoni* is named in honor of Dr. K. C. Emerson, who gave us much encouragement and supplied many specimens and data.

Ricinus dendrobacae, new species

Type locality: Casa Lake, Minnesota.

Type host: *Drepanis striata* (Forster).

Diagnosis.—A medium-sized species from *Paradise*. Closely related to *R. pictus*. Mandibles characteristic; tips narrow and hooked. Setae 1 and 2 each with two sensillae; anterior pair paraxial.

Table 12

<table>
<thead>
<tr>
<th>Character</th>
<th>Dendrobacae</th>
<th>Dendrobacae</th>
<th>&quot;Paradise&quot;</th>
<th>Dendrobacae</th>
<th>Dendrobacae</th>
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<tr>
<td></td>
<td>n = 18</td>
<td>n = 14</td>
<td>n = 12</td>
<td>n = 11</td>
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<td>3.37</td>
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<td>0.67</td>
<td>0.67</td>
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<td>0.29</td>
<td>0.25</td>
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<td>0.30</td>
<td>0.32</td>
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<td>0.53</td>
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<td>46a</td>
<td>46a</td>
<td>46a</td>
<td>46a</td>
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</tbody>
</table>

widerly separated from 1a; setae 6 absent; antennal lappets each with ten or fewer setae. Setae L5 longer than L6. Pleurae pigmented to margin; color obovate. Margin of mesonotic entire; spines of stout parameres each with three setae. C4 longer than C3. Stermites VI-VII with golden pigmented markings.

Description.—Head as in pl. 25, fig. 1. Mandibles as in pl. 25, fig. 2. Labium with 14 pairs of setae; pattern as in pl. 25, fig. 2. Setae 1 and 2 each with two sensillae; anterior pair paraxial. Maxillary plates smooth-sloped; palpi geniculated. Setae 3r longer than 3a series. Gular plate as in pl. 25, fig. 1; number of setae 2 x 2 x 4 x 4; average 2.1 x 2.1. Setae along antenntal lappets variable in number, 5 x 5 x 10 x 10; average 7.4 x 7.4. Po series nearly equal in size and shape.

Proxemus as in pl. 25, fig. 5; L5 longer than L6; L7 and L8 long; L9 small. Coxa 1 and femur 1 with two long tactile setae. W series and q strongly spinose. C4 longer than C3. Serral plate and setae as in pl. 22, fig. 5. Short tactile setae on coxa II; long tactile setae on femur III.

Terminal segments of female abdomen as in pl. 23, fig. 6. Pleurae pigmented to margin; color obovate. Chaetotaxy of ventral pleurae as given in table 4. Stermites VI and VII with golden markings. Male gonad as in pl. 23, fig. 6. Margin of mesonotic entire. Parameres stout, spines each bearing three setae. Nodi obovate; background whitish.

Dimensions.—See tables 13 and 14.
**Distribution.** Known from the genus *Dendroica*, family Parulidae. A population collected by H. S. Peters from a Caribbean island and labeled “Winter” is assigned to *D. dendroica*.

<table>
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<th>Character</th>
<th><em>Dendroica cerulea</em></th>
<th><em>Dendroica pallasii</em></th>
<th><em>Dendroica cerulea</em></th>
<th><em>Dendroica magnolia</em></th>
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<td>50a</td>
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<table>
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<td>0.49</td>
</tr>
<tr>
<td>Distance between prosternals</td>
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August 1936 by H. S. Peters. From *Dendroica magnolia* (Wilson): 1♀ paratype (INHS); no data; 1♂ paratype (UM) from Eau Claire, Wisconsin, on 14 September 1961. From *Dendroica cerulea* (Lampeaux): 1♀ paratype (UM) from Minnesota; 1♀ paratype (USNM) from Harrisburg, Berkshire, on 10 February 1942 by H. B. Bower; 1♂ paratype (USNM) from Wilmington, North Carolina, on 31 March 1966 by Peters and Litch. From *Dendroica pallasii* (Gmelin): 1♀ paratype (UNH) from Durban, Stafford Co., New Hampshire, on 4 June 1964 by J. E. Reina. From *Dendroica pallasii* (Suter): 1♂ paratype (USNM) from Chancy Chase, Maryland, on 6 September 1933 by W. H. Bell; 1♂ paratype (USNM) from Madison, Wisconsin, on 24 May 1952 by W. T. Woodman. From *Dendroica cerulea* (Lampeaux): 4♀ paratypes (BCN 701, 705) from Miami, Florida, on May 1919 and 23 July 1928 by J. E. Reina; 1♂ paratype (UM) from Carlos Avery, Anoka Co., Minnesota, on 29 September 1961 by J. Dyer. From *Dendroica pinus* (Wilson): 3♀, 3♂ paratypes (BMNH 12398) from Arizona on March 1939 by H. E. Rembert; 2♀ paratypes (CJ, SR) from East College, Maryland, on 14 January 1936 by H. W. Stafford; 1♂ paratype (USNM) from Gulfport, Mississippi, on 11 February 1916; 1♂ paratype (UM) from Raleigh, North Carolina, on 19 March 1957 and 5 April 1957 by B. E. Deans. From *Dendroica ruficoda* (Vieillot): 2♂ paratypes (RCF) from Leon Co., Florida, in spring 1958 by H. L. Stoddard; 5♂ paratypes (USNM) from same locality in spring 1969 by B. McDaniel; 1♀ paratype (USNM) from Chancy Chase, Maryland, on 3 August 1952 by W. H. Bell; 1♂ paratype (USNM) from Orange City, Iowa, on 21 September 1953 by H. S. Peters; 2♂ paratypes (USNM) from Mayaguez, Puerto Rico, on 7 Feb-
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Number 1936 by H. L. Doucer; 1 2 paratypes from Virginia Gorda, West Indies, on 10 December 1889. From Dendroica pammelas (Gmelin) 1 2 paratypes (USNM) from Peledora, North Carolina, on 12 December 1942 by O. O. Babler. From "Waterfall" 2 3 (USNM) from Cayo Perla, Cuba, on 2 September 1929 by H. S. Peters; 1 2 (USNM) from British West Indies and Cuba in September 1929 by H. S. Peters. From Wood Duck, stragglers 1 (NNIS) from Harvard, Illinois, on 12 November 1933 by P. Hunt.

Remarks.—The population of Rixius from various species of Dendroica appear to be one species. However, an interesting variation has appeared in collections from D. petechia. The specimens from Minnesota, New Mexico, and New York are typical D. petechia. Specimens from Florida and Cuba differ from typical D. petechia only in the pigmentation of the pleurites. Only the nudes are pigmented in the southern specimens. Because only a few specimens are known from each locality, I have not separated the southern populations taxonomically. Further collecting is necessary to determine whether subspecies or species is developing within the populations of Rixius from D. petechia.

Rixius seuri, new species

Type locality: Long Island, New York.

Type host: Seurius murcaronatus (Gmelin)

Diagnosis.—Target species of Rixius occurring on Parulidae. Mandibles characteristic; tip long, thin, and hooked as in E. petechia. Head shape characteristic, elongated. Color brown; pleurites pigmented to margin. All sternites pigmented, light golden-brown. Tergites lightly pigmented. More than nine setae along antennal lappets. Mesosoma thick, upper margin pigmented. Parameres each with four or five apical setae. Setae c4 twice as long as c3. Setae c6 and c7 twice as long as c6.

Description.—Head shape as in pl. 26, fig. 1. Pronotal laciniations not fused with narrow transverse carina. Mandibles characteristic as in pl. 26, fig. 2. Labium with 13 pairs of setae, as in pl. 26, fig. 2. Maxillary plates narrow, palpi globose. Labrum and tectal nodi equal in size. Setae m2 situated medially on marginal carinae. Setae m3 three times as long as m4. Setae m1 short, each with two setae, antenna widely separated from setae m2; setae m3 absent. Gular plate as in pl. 26, fig. 1; number of setae 1 to 3 x 2, average 2 x 2. Number of setae along antennal lappets 8 to 9 to 11, average 9.5 x 9.5. To series m3 nearly equal in size.

Prothorax as in pl. 26, fig. 5; L and W long. Femur I with three tactile setae; coxa I with two. Setae m3 twice size of m2; 2 x setae in m series. Setae c4 long. Setae c6 twice as long as c6. Setaal plate as in pl. 26, fig. 2, 5. A short tactile seta on coxa II; a long tactile seta on femur III.

Terminal segments of abdomen of female as in pl. 26, fig. 4. Mesosome thick; upper margin pigmented; lower margin entire. Parameres broad, apices each with four or five setae.

Dimensions.—Females (n = 12); total length 3.03-3.37 (3.10); greatest width 0.90-0.99 (0.95); head length 0.75-0.78 (0.76); head width 0.63-0.69 (0.66); head index 112-117 (116); labial width 0.23-0.24 (0.24); prothoracic length 0.22-0.23 (0.23); prothoracic width 0.23-0.25 (0.23); distance between prosternal 25-34 (30); Midas (n = 5); TL, 0.90-1.15 (1.04); GW, 0.81-0.83 (0.82); HL, 0.68-0.69 (0.68); IW, 0.61-0.61 (0.61); HI, 133-137 (115); LW, 0.29; PL, 0.29; PW, 0.49-0.50 (0.50); distance between prosternum 25-34 (30); width of genista 0.17-0.19 (0.18).

Distribution.—Known from 10 species in parallel genus Seurius.

Material examined.—From Seurius murcaronatus (Gmelin): 1 holotype, 2 allotypes 1 (both on same slide) and 2 paratypes (KCC) from Long Island, New York, by R. S. Peters; 2 3 6 (USNM) from Dendroica pammelas (Gmelin) 1 2 paratypes (USNM) from Dendroica pammelas (Gmelin).

Remarks.—This taxon is characterized by a unique combination of characters found in both the holotype and allotypes. It is distinguished from all other species of Rixius by the following features: total length 3.03-3.37; greatest width 0.90-0.99; head length 0.75-0.78; head width 0.63-0.69; head index 112-117; labial width 0.23-0.24; prothoracic length 0.22-0.23; prothoracic width 0.23-0.25; distance between prosternal 25-34; Midas (n = 5); TL, 0.90-1.15; GW, 0.81-0.83; HL, 0.68-0.69; IW, 0.61; HI, 133-137; LW, 0.29; PL, 0.29; PW, 0.49-0.50; distance between prosternum 25-34; width of genista 0.17-0.19.

Prothorax hexagonal as in pl. 27, fig. 6; margin between L2 and L3 straight or slightly concave; posterior margin nearly straight; L5 shorter than L6. Setae c4 equal to c3; setae in c6.
**Echius wolf**

**New species**

**Type locality:** Tarpon Springs, Florida.

**Host:** *Amphibia caroliniana* (Lichtenstein). 

**Description:** A species belonging to the *subgenus Amphibio* species group with short, thick mandibular tips. Shaped related to *E. subabastatus*. Shape of mandibular tip characteristic, not notched below. From flattened median, pigmented pattern of gular plate swollen anteriorly, plate with usually three pairs of setae. More than nine setae along anterior lappets. Shape of prothorax...


Diagnosis—A slightly sclerotized species of the subangulatus species group with needle-like mandibles. Upper mandibles with broad base and incurved, unci-like tips. Lower mandibles strongly curved, with a large, toothed projection near the base. Setae c6 and c8 short and equal in length. Setae c4, c5, and c6 long and equal.

Description.—Head as in pl. 28, fig. 1: front rounded, with transverse carina parallel with margin of front. Mandibles as in pl. 28, fig. 2. Labium with 14 pairs of setae, pattern as in pl. 28, fig. 5. Pattern on head scutellum as in pl. 28, fig. 5. Setae m1 on inner margin of marginal carina; m2 twice as long as m3. Setae a1 and a2 equal; a3 strongly spinose, equal in length. Setae c1 and c2 of body, 10-12, average 9.3 x 9.25.

Prothorax as in pl. 28, fig. 5; l2 greater than l6; l7 and l8 long; l6 more anterior than in most Ricinus; no slight indentation at insertion of L4. Sternal plate as in pl. 28, fig. 2; bearing two pairs of long setae and one posterior pair longer than the others. Six setae in s series; w1 and w2 strongly spinose, equal in length, w3 and w4 weakly spinose, s4 and s5 strongly spinose, s6 and s7 weakly spinose, s8 and s9 spinose, s10 equal in length. Setae c1 and c2 of body, 10-12, average 9.3 x 9.25.

Dimensions.—Female (n = 5): total length 4.20-4.38 (4.28): greatest width 1.03-1.18 (1.18); head length 0.62-0.72 (0.67); head index 106-112 (110); head width 0.62-0.67 (0.65); prosternum width 0.62-0.67 (0.65); prosternum length 0.41-0.46 (0.43); distance between pronotum 0.67-0.82 (0.76).

Distribution.—Found on species of Tanaorga and Tanaorga, family Tanaorgidae. The single specimen from Elasmos focussus is probably a contaminant or straggler.

Material examined.—From Thripus epiposicus conicus (Swainson): holotype Q (USNM 85286) from Juan Vicente, Rivas, Nicaragua, on 23 May 1992 by M. A. Carriker, Jr. From Tremeoia epiposicus adavus (Lessons): 1 (USNM) from Tija zinc, Mexico, on 17 May 1940 by M. A. Carriker, Jr. From Thripus reacherstia (Berlese): 1 (USNM 85785) holotype of Ricinus conicus from Coahuila, Mexico, on 9 September 1910 by M. A. Carriker, Jr. From Thripus phaeotus (Wald.) 3 (BMNH) from Port Beul, Trinidad, on 18 March 1966 by T. H. G. Atten, from Elasmos focussus (Thunberg), et al. (7): 1 (USNM) from Tananta reacherstia (Berlese), on 15 August 1906.

Remarks.—There is some confusion concerning the type host of R. subangulatus. Carriker (1945) stated that he collected the type series from Tananta conicus (Swainson). In 1949 he corrected the host to Thripus epiposicus adavus (Lessons). Hopkins and Clay (1952) referred the host to Tananta epiposicus (Swainson). The label on the holotype present in the U. S. National Museum gives the host as Thripus conicus. There appears to be some confusion regarding the correct name for the Blue-rayed Tanaorg. Modern checklists use the name conicus rather than epiposicus. Both conicus and adavus are considered subspecies of epiposicus. In addition, epiposicus has been placed by some entomologists in Thripus

Nelson: Revision of the New World Species of Ricinus

and by others in Tanaza. The Check-list of Mexican birds (1957) and De Schauensee (1966) place epiposicus in Thripus. The names proposed for the type host actually refer to the same host but not to the same subspecies. No evidence is available to indicate that different species of Ricinus occur on two different subspecies of host. Therefore the exact determination of the subspecies appears to be unimportant.

Ricinus complicatus Carriker, 1914


Diagnosis.—A heavily sclerotized species of the subangulatus species group with needle-like mandibles. Closely related to R. complicatus. Mandibles characteristic; tips shorter than those of T. complicatus. Shape of gnathos plate characteristic, broad. Nodi of head larger than in T. complicatus. Steral spine characteristic, as in pl. 30, fig. 4. Setae q5 not strongly spinose, shorter than w3. Maxillary plate wider than T. complicatus.

Description.—Head as in pl. 29, fig. 1: margin of front continuous with that of marginal carina. Transverse carina straight; front rounded. Mandibles as in pl. 30, fig. 2. Labium with 14 pairs of setae, pattern as in pl. 30, fig. 3. Setae a1 each with two serrulae, position of serrula variable. Setae a2 twice as long as pa series. To series all equal in length, Maxillary palp 4 wide, 15 strongly spinose, palpal gestalt. Maxillary plate as in pl. 30, fig. 1, broad; setae number 2 = 2. Setae along antennal hapters number 9, 11, 10, and 9 = 10 (type), Nodi of head large.

Prothorax as in pl. 30, fig. 4: slightly indented at insertion of L1; L2 larger than L6. Sternal plate as in pl. 30, fig. 4; bearing two pairs of long setae. Setae c1 more than c10; c12 and c13 equal. Setae e1 in w series. Setae q5 not strongly spinose, shorter than w3.

Terminal segments of female abdomen as in R. complicatus. Male in terminal segments as in R. complicatus. Mandible of each pair moderately broad, sternum and lateral setae as long as c. A heavily sclerotized species. Nodi and incursions dark brown; background and legs golden-brown.

Material examined.—From Tachypus phaeotus, family Thripidae.

Distribution.—Known only from the type host Tachypus phaeotus, family Thripidae. Material examined.—From Tachypus phaeotus (Hoffmeister): holotype Q (USNM 85780) from El Callao, Estado Bolivar, Venezuela, on 2 March 1910 by M. A. Carriker, Jr. 6 (USNM) from Pueblo Nuevo, Colombia, on 30 September 1936 by M. A. Carriker, Jr.

Ricinus raphoei, new species

Type locality: Fort Royal, Trinidad.

Type host: Raphoeis botkinii (Palmaris).


Maxillary plate thin; maxillary gestalt. Maxillary plate as in pl. 31, fig. 1, setae number 2 = 2. Setae along antennal hapters variable in number, 7-9 x 11-12, average 10.5 x 10.5.

Prothorax as in pl. 31, fig. 4; slightly indented at insertion of L1; L5 longer than L6. Csa 1
Ricinus volatilis, new species

Type locality: Brazil Village, Trinidad.

Type host: Fea florica (Hickson).


Description: Setae as in pl. 32, fig. 5. Rhabdophaga (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.

Material examined: From Rhabdophaga carbo (Pallas), family Thysanopilidae.
### TABLE 15

**MEAN AND RANGE OF MEASUREMENTS OF FEMALES OF RICINUS VERUSCUM POPULATIONS**

<table>
<thead>
<tr>
<th>Character</th>
<th>Value (n = 10)</th>
<th>Value (n = 9)</th>
<th>Value (n = 8)</th>
<th>Value (n = 7)</th>
<th>Value (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
<td>3.93</td>
<td>3.85</td>
<td>3.85</td>
<td>4.02</td>
<td>3.92</td>
</tr>
<tr>
<td>Greatest width</td>
<td>1.02</td>
<td>0.97</td>
<td>0.97</td>
<td>1.07</td>
<td>1.07</td>
</tr>
<tr>
<td>Head length</td>
<td>0.73-1.11</td>
<td>0.94-1.02</td>
<td>0.94-1.06</td>
<td>0.95-1.08</td>
<td>0.95-1.08</td>
</tr>
<tr>
<td>Head width</td>
<td>0.75</td>
<td>0.73</td>
<td>0.73</td>
<td>0.73</td>
<td>0.73</td>
</tr>
<tr>
<td>Head index</td>
<td>0.71-0.79</td>
<td>0.72-0.74</td>
<td>0.72-0.76</td>
<td>0.74-0.78</td>
<td>0.74-0.78</td>
</tr>
<tr>
<td>Labral width</td>
<td>0.35</td>
<td>0.35</td>
<td>0.36</td>
<td>0.36</td>
<td>0.36</td>
</tr>
<tr>
<td>Prothoracic length</td>
<td>0.36-0.37</td>
<td>0.36-0.37</td>
<td>0.36-0.37</td>
<td>0.36-0.37</td>
<td>0.36-0.37</td>
</tr>
<tr>
<td>Prothoracic width</td>
<td>0.65</td>
<td>0.63</td>
<td>0.64</td>
<td>0.67</td>
<td>0.66</td>
</tr>
<tr>
<td>Distance between prothorax</td>
<td>0.65-0.66</td>
<td>0.65-0.66</td>
<td>0.65-0.66</td>
<td>0.65-0.66</td>
<td>0.65-0.66</td>
</tr>
</tbody>
</table>

### TABLE 16

**MEAN AND RANGE OF MEASUREMENTS OF MALES OF RICINUS VERUSCUM POPULATIONS**

<table>
<thead>
<tr>
<th>Character</th>
<th>Value (n = 10)</th>
<th>Value (n = 9)</th>
<th>Value (n = 8)</th>
<th>Value (n = 7)</th>
<th>Value (n = 6)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total length</td>
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<td>3.24</td>
<td>3.24</td>
<td>3.27</td>
<td>3.28</td>
</tr>
<tr>
<td>Greatest width</td>
<td>0.83</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
<td>0.85</td>
</tr>
<tr>
<td>Head length</td>
<td>0.73-1.11</td>
<td>0.74-0.77</td>
<td>0.74-0.75</td>
<td>0.74-0.77</td>
<td>0.74-0.77</td>
</tr>
<tr>
<td>Head width</td>
<td>0.66</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
<td>0.64</td>
</tr>
<tr>
<td>Prothoracic length</td>
<td>0.62-0.69</td>
<td>0.62</td>
<td>0.62</td>
<td>0.62</td>
<td>0.62</td>
</tr>
<tr>
<td>Prothoracic width</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
</tr>
<tr>
<td>Distance between prothorax</td>
<td>114</td>
<td>116</td>
<td>116</td>
<td>116</td>
<td>116</td>
</tr>
<tr>
<td>Prothoracic length</td>
<td>0.65</td>
<td>0.65</td>
<td>0.65</td>
<td>0.65</td>
<td>0.65</td>
</tr>
<tr>
<td>Prothoracic width</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
<td>0.69</td>
</tr>
<tr>
<td>Distance between prothorax</td>
<td>56-63</td>
<td>64-66</td>
<td>64-66</td>
<td>64-66</td>
<td>64-66</td>
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<tr>
<td>Width of genitalia</td>
<td>0.18-0.20</td>
<td>0.18-0.20</td>
<td>0.18-0.20</td>
<td>0.18-0.20</td>
<td>0.18-0.20</td>
</tr>
</tbody>
</table>

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**Ricinus diffusus Species Group**

**DIAGNOSTIC CHARACTERISTICS**

1. Oviducts elongate, finely pitted, grayish in appearance.
2. Mandibles misosomeophic.
3. Prothorax broadly hexagonal, with "shovel" antennal lamina to 6.
4. Head conical, from rounded, margins not continuous with sides of head; sides of head diverging; cerci weakly evaginated.
5. Pattern on terminal segments of female-"H"s, M, M2, except in R. australis.
6. Prosternal setae moderately spaced.
7. Gular plate with posterior lateral projections.
8. Setae 6a with two sensillae, a3 absent.
9. Male genitalia as in subspecies species group.
10. Setae 6b and 4g present.
11. Margin of labium concave medially.
12. Hystrix tuberculoid; plates muscle-shaped.
13. Larval nidi present; tentacular reduced, posterior pits very reduced.

**Ricinus subdiffusus, new species**

Type locality: Hopland Field Station, Mendocino Co., California.

**Type host:** *Spilosteus pacifica* (Bachman).

**Diagnosis:** A small species of the *Ricinus* species group, related to *R. sertifer* and *R. diffusus*. Head with four rounded, transverse carinae straight. Shape of mandibles characteristic. Labium with 14 pairs of setae. Larval nidi equal to terminal nidi in size. Pigmented area of gular plate wide; setae on gular plate equal to maxillary setae; anterior nidi as long as 6. Gular plate smooth anteriorly; prothorax hexagonal. Setae on sternites II-IV short; sternal lateral setae of V-VI as long as mentalia; sternal medial setae as long as maxillaries. Pigmentation of sternites VII and VIII more extensive than in *R. diffusus*. Plicatures pigmented, more obvious in color, margin shorter. Parameres of male genitalia stout. Two long terminal setae on cea 1.

**Description:** Head as in pl. 24, fig. 1; from rounded; transverse carinae straight. Mandibles as in pl. 24, fig. 2. Labium with 14 pairs of setae, pattern as in pl. 24, fig. 2. Maxillary plates muscle-shaped; palps tuberculoid, reaching past margin of head. Mentalia setae longer than maxillaries. Seta 6b off marginal carinae; 6b three times as long as pa setae. Setae 6a short, each with two sensilla; posterior pair close to 6a; anterior pair lateral to anterior terminal nidi; a6 present. Larval nidi equal to terminal nidi; 6a setae 6b weakly spinose, slightly shorter than pa. Gular plate as in pl. 24, fig. 1; number of setae 2x 2; anterior nidi equal to maxillaries; posterior pair equal to 11. Number of nidi along terminal raphe 9-9 to 11-11, average 10.5 ± 1.2. Prothorax hexagonal, as in pl. 34, fig. 2. Prothoracic plate as in same figure. 3.5-5 longer than L6. Coxal plate spinose in size. Coxa 2 and femor A each with two long terminal setae; W series with six setae; w6 and w7 weakly spinose; w3 as long as w7. Femur clavately strongly but some strongly spinose than cl; e3 and e4 equal in size. Sternal plate as in pl. 34, fig. 5; narrow anterad. Coxa 21 and femor A each with a short terminal setae; femor A with a long terminal setae.

### Terminalsegments of female abdomen as in pl. 34, fig. 6. Plicatures pigmented to margin; color ocelloids. Gonostaxy of ventral plicatures as given in table 4. Vexila with 7 to 10 setae; average 9. Setae of sternites II-IV short; sternal lateral setae of sternites V and VI as long as mentalia; sternal medial setae as long as maxillaries. Pigmentation of sternites VII and VIII more extensive than in *R. diffusus*. Male genitalia as in pl. 34, fig. 4. Margin of mesosome ending in a medium blunt point. Parameres stout, apices each with three setae. Nodi of head, thorax, and pleures and coxal, background whitish.

**Dimensions:** Females (n = 7): total length 3.35-3.74 (3.55); greatest width (n = 7): 0.97-1.06 (1.00); head length 0.70-0.77 (0.73); head width 0.64-0.72 (0.68); hind index 101-110 (107); larval width 0.28-0.34 (0.31); prothoracic length 0.55-0.68 (0.65); prothoracic width 0.57-0.65 (0.60); distance between prothorax 63-65 (55). Males (n = 3): T1 3.02-3.17 (3.08);
Rinus sittae, new species

Type locality: Pomo Robles, California.

Type host: Sitta carolinensis Linnaeus.


Description.—Shape of head as in pl. 35, fig. 1; from rounded, transverse carina convex. Mandibles as in pl. 35, fig. 3. Labium with 14 pairs of setae, pattern as in pl. 35, fig. 2. Setae m2 on marginal carinae; m2 slightly larger than m1 setae. Maxillary plate sauce-shaped; palpi galeiform, barely reaching margin of head. Mental setae equal in length to maxillary setae. Setae n1 short, with two serrulae; 46 short. Setae p1 laevifrons as long as p1; p2 short. Culinar plate as in pl. 35, fig. 1; number of setae n2 4-2. Eight setae along antennal lappet.

Prothorax hexagonal, as in pl. 35, fig. 4; bearing two pairs of long setae; posterior pair short. Six setae in v series; v3 and v6 weakly sclerotized. Setae of equal size in v3. C1 twice as long as c2; c3 shorter than c4. Seta 1 with one tactile seta; seta 2 with two tactile setae; seta 3 with 1 tactile seta; seta 4 with one tactile seta. Pleuralia pigmented to margin; color laevifrons. Setae on cerci 11-17, small. Chaetotaxy of ventral pleurites as given in table 4. Abdomen narrow. Male genitalia as in pl. 35, fig. 5. Margin of mesosome bearing a median blunt point; apices of parameres each with three setae. Nodi of head, thorax, and pleurites laevifrons in color: background whitish.

Female unknown.

Dimensions.—Measurements of type given first: total length 2.90 and 2.91; greatest width 0.69; head width 0.63 and 0.64; head width 0.60 and 0.61; head length 0.55; prothoracic length 0.43; prothoracic width 0.48; distance between pronotal 0.53; male genitalia, length 0.14 and 0.18.

Distribution.—Known from two specimens taken from *Sitta carolinensis* Linnaeus, family Fringillidae.

Material examined.—From *Sitta carolinensis* Linnaeus: holotype ♀, paratype ♂ (VLR 111-849) from Pomo Robles, California, in 1869 by B. Chapman.

*Rinus difusus* (Kellogg, 1906)

### TABLE 17
**Mean and Range of Measurements of Females of Rheinau Rossii Populations**

<table>
<thead>
<tr>
<th>Character</th>
<th>Passerinae</th>
<th>Zuestrichia</th>
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<td>106-112</td>
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<td>0.08-0.10</td>
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<tr>
<td>Prothoracic width</td>
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<td>0.54-0.60</td>
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<td>0.54-0.60</td>
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<tr>
<td>Distance between prostates</td>
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<td>69μ</td>
<td>61μ-76μ</td>
<td>69μ</td>
<td>61μ-76μ</td>
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### TABLE 17 (Continued)

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<td>0.22</td>
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**Notes:**
- **Nelson:** Revision of the New World Species of Ricinula
- **Material examined:** From *Pamerella sandwichensis* (Gmelin): 1 ♀ (VLK 334a) from Stanford University, California, in 1896 by V. L. Kellogg; 9 ♀ (BCN 713) from Miami, Florida, in December 1961 by J. A. Weber; 1 ♀ (USNM) from Martha’s Vineyard, Massachusetts, on 23 April 1937 by L. R. L выше Jr.; 1 ♀ (USNM) from McMillan, Michigan, on 30 May 1932 by O. M. Bryan; 1 ♀ (USNM) from Lincoln, Nebraska, on 18 April 1901 by M. A. Carrick Jr.; 1 ♀ (USNM) from Durham, North Carolina, on 29 September 1931 by D. E. Ruml; 1 ♀ (USNM) from Beaver, Pennsylvania, in May 1908 by M. A. Carriker Jr.; 1 ♀ (USNM) from Georgetown, South Carolina, on 25 March 1933 by Peter and Lens; 1 ♀ (USNM) from Chuckwalla, Manitoba, Canada, on June 1934 by A. M. Hurdrein; from *Pamerella princeps* Maynard: 1 ♀ (BCN 711) from Miami, Florida, on 28 December 1929 by J. A. Weber, from *dendrodactylus setiferus* (Gmelin): 1 ♀ (VLK 841) from Pico Del Robin, California, in 1959 by A. Chapman. From *Anoplocnemis marmorata* (Wilson): 1 ♀ (BCN 717) from Miami, Florida, on 17 June 1932 by J. A. Weber. From *Juno cervinipes* (Townsend): 1 ♀, 2 ♀ (USNM) from Fremont, Harner Co., Oregon, on 2 February 1936 by S. O. Jewett. From *Spessardus arborus* (Wilson): 1 ♀ (USNM) from Lincoln, Nebraska, on 5 January 1901 by Crawford; 1 ♀ (USNM) from Monbok Lake, New York, on 8 April 1931 by B. Smiley, Jr.; 1 ♀ (USNM) from Iowa, New York, on various days from January to April 1935 by A. M. Hurdrein; 1 ♀ (KCN) from vicinity of Dugway Valley, Utah, on 13 May 1935 by R. Porter. From *Spessardus penicillatus* (Bohemian): 2 ♀ (USNM) from Champaign, Illinois, on 24 December 1935 by J. R. James; 1 ♀ (USNM) from Gates Mill, Ohio, on 6 April 1933 by M. R. Peters. From *Zonotrichia luteola* (Forster): 2 ♀ (USNM) from Winchester, New Hampshire, on 12 May 1932 by L. E. Nelson; 1 ♀ (USNM) from Lestonia, Ohio, on 11 May 1933 by M. R. Peters; 3 ♀ (USNM) from Sonora, Texas, on 26 February 1934 by O. B. Beecher. From *Zonotrichia atricapilla* (Gmelin): 3 ♀, 2 ♀ paralectotypes (VLK 533a) from Palo Alto, California, in 1906 by V. L. Kellogg; 5 ♀ (BCN 458) from Russell Field, Costra Costa Co., California, on 1 March 1966 by W. A. Smitt; 2 ♀ (USNM) from Portland, Oregon, on 1 April 1923 by N. Gabrielson. From *Zonotrichia albiceps* (Gmelin): 2 ♀ (KCN) from St. Joseph, Missouri, on 26 April 1931; 2 ♀ (USNM) from Monbok Lake, New York, on 23 April 1938; 1 ♀ (USNM) from Madison, Wisconsin, on 30 April 1933 by P. Hickey. From *Pamerella claireae* (Meredith): 1 ♀ (USNM) from Dadeboro, Mississippi, on 12 February 1935 by D. M. Bryan Jr.; 1 ♀ (USNM) from Elkmont, Alabama, on 25 October 1935 by W. M. Beal; 1 ♀ (USNM) from Columbus, Ohio, on 13 March 1926 by H. H. Peters; 1 ♀ (OCNM), no collection data. From *Melocicada gregaria* (Latham): 1 ♀ (USNM) from Jackson, Michigan, on 20 June 1930 by W. G. Fargo; 2 ♀ (KCN) from Vicksburg, Mississippi, on 6 January 1944 by M. L. Miles; 2 ♀ (USNM) from Conway, South Carolina, on 31 March 1933 by Peters and Lens. From *Horodinella wolfei* (Wilson): 1 ♀, 2 ♀ (VLK 535a) from Palo Alto, California, on 21 and 23 March 1896 by R. E. Stogdell; 1 ♀ (VLK 621) from same locality in 1897; 5 ♀ (USNM) from Ft. Duport, Delaware, on 13 April 1933 by Peters and Lens; 1 ♀ (BCN 714) from Miami, Florida, on 13 November 1900 by J. A. Weber; 1 ♀ (USNM) from Mackinac Co., Michigan, on 5 June 1909 by W. G. Fargo; 4 ♀ (USNM) from Ithaca, New York, on 28 April and 3 May 1930 by A. B. Klotz; 1 ♀ (USNM) from Gates Mill, Ohio, in April and May 1932 by H. H. Peters; 2 ♀, 2 ♀ (USNM) from Lakeview, Ohio, on 11 June 1929 and 4 March 1930 by E. O. Hoffstetter, Host unknown: 1 ♀ (BMNH, syntype of *E. clarki*) from Arctic America by Captain Bock in 1852–1853. The following records are designated as cases of straggling or contamination: From *Pamerella anna* (Say): 1 ♀, 1 ♀ (USNM) from Sinukas Co., Nebraska, on 1 June 1901 by M. A. Carrick Jr.; From *Pamerella anna* (Linnaeus): 1 ♀, 1 ♀ (VLK 690a) from Palo Alto, California, in 1966 by H. Carrick. From *Euphorbus cinctus* (Linnaeus): 1 ♀ (VLK 688a) from Palo Alto, California, in 1897 by V. L. Kellogg. From *Euphorbus cinctus* (Linnaeus): 1 ♀ (VLK 688a) from Palo Alto, California, in 1897 by V. L. Kellogg.
whether the specimens designated as "diffusum" by Kellogg from Z. atricapailla and other hosts in the Kellogg collection were conspecific with specimens from P. sandrechaevis. Study has shown that P. diffusus does have a wide host distribution.

Two "different" forms are found in populations of P. diffusus based on the shape of the frons and an accompanying difference in the shape of the ociput. Both of these forms can be found in the same population of specimens and in the same host. These different interpretations are artifices resulting from pressure of the coverslip on the frons and ociput. Because of the lack of other differentiating characters I have assigned these specimens to one species.

In 1917 McGregor described Physostomum melapiace from Melopsia melapia. He gave the total length of the female as 2.17 mm, which would make this species the smallest known Ricianus. My examination of the type revealed that his two syntypes were nympha. Since two species of Ricianus, R. fringilliae and R. diffusus, occur on M. melapia, a comparison of the syntypes was made with nymphs of these two species. The syntypes resemble the nymphs from R. diffusus. R. melapiace is designated a junior synonym of R. diffusus (Kellogg).

In his description of R. capensis based upon a female specimen from Zonotrichia capensis, Savannah-Schäfer (1936-37) gave features that are applicable to most species of Ricianus. His photographs revealed a specimen that is inadequately cleared and that resembles R. diffusus. His drawing of the specimen showed a pattern of chromatography that is unique, so much so that I believe that the pattern has been grossly misinterpreted. R. capensis must be referred to either as a species inquirendae or as a junior subjective synonym of R. diffusus. Other species of Zonotrichia are infested with R. fringilliae and R. diffusus. I have chosen the latter name.

Ricianus calcarii, new species

Type locality: Golovin, Alaska.

Type host: Calogonia errata (Townsend).

Diagnosis.—A large species of the diffusus species group. Closely related to R. thoracicus. Shape of head characteristic, as wide as long. Frontal carinae straight. Labium with 15 pairs of setae, longer than at.

Description.—Head as wide as long, as in pl. 37, fig. 1. Transverse carinae straight; frons rounded. Mandibles as in pl. 37, fig. 5. Labium with 15 pairs of setae, pattern as in pl. 37, fig. 2. Setae n2 off marginal carinae, m3 and m4 on medial on marginal carinae; m4 twice as long as pm series. Setae s1 longer than s2, even with twoarella, both equal distance from each other. Po series as in transverse. Gular plate as in pl. 37, fig. 1; number of setae 2 x 3 to 4 x 4, average 2 x 3; number of setae along antennal lappets variable, 10 x 11 to 14 x 15, average 12.5 x 12.5. Prothorax as in pl. 37, fig. 4. Setae on each side of thorax, both equally absent from apes. Euphorax as in pl. 37, fig. 2. Prothorax as in pl. 37, fig. 4. Setae s1 longer than any seta of w series. Five or six setae on w series: m6 and w6 short.

Terminal segments of female abdomen as in pl. 39, fig. 2. Pleurites lightly pigmented to margin: m4 dark brown. Chorion of ventral pleurites as in pl. 4; pleurites on pleurite IV all stippled. Antennal lappets twice as long as other two lappets. Valsa with 2 to 3 setae, average 4.5. Malar galea as in pl. 37, fig. 5. Margin of maxilla with medial blunt tip. Apex stout, each bearing three setae.

Dimensions.—Female (n = 8): total length 4.49-4.87 (4.60); greatest width 1.31-1.58 (1.47); head length 0.85-0.90 (0.88); head width 0.84-0.86 (0.85); head index 86-104 (91); labial width 0.36-0.40 (0.39); proboscis length 0.03-0.04 (0.03); mouthparts width 0.30-0.32 (0.31); distance between proboscises 0.38-0.44 (0.40); Malar (n = 2): TL, 3.67, 3.79; GW, 1.03-1.05; HW, 0.75, 0.77; LW, 0.74, 0.75; HW, 100, 102; LW, 0.33, 0.34; PL, 0.18, 0.19; PW, 0.04, 0.05; distance between proboscises 0.48-0.54 (0.49); width of genialia 0.20-0.21 (0.20).

Ricianus thoracicus (Packard, 1870)

N. thoracicus Packard, 1870, see Finger, 1880. Amer. Nat. 11: 40, pl. 1, fig. 5. Type locality: not recorded. Type host: Phoebopus polystigma (Linnicurus).


Description.—Head as in pl. 38, fig. 1: wider than long, head index 93; frons short, rounded; frontal carinae parallel to margin of frons. Mandibles as in pl. 38, fig. 5. Labium with 15 pairs of setae, pattern as in pl. 38, fig. 2. Mental setae longer than maxillici. Maxillate plate smooth-scaled; palpi genicularis, reaching past margin of head. Lower nodule larger than terminal nodule. Setae n2 off marginal carinae; m3 and m4 on medial; m4 more than twice as long as pm series. Setae pel spine; pol; plisse, twice as long as pol; pol; plisse, variable in length. Setae s1 short, each with twoarella, both usually equal distance from apes. Euphorax of temple blunt. Gular plate as in pl. 38, fig. 1; number of setae 2 x 3 to 3 x 4, average 2 x 3; number of setae along antennal lappets variable, 10 x 13 to 13 x 16, average 13 x 13. Prothorax broad, as in pl. 38, fig. 4. L4 as long as L5, both longer than L6. Prosternal and anterior plates as in pl. 38, fig. 4. Setae c1 much longer than c2; c2 and c4 shorter than c1 in length. Setae w on w series: w1-4 spinules, w5-6 short and plisse. Setae d2 strongly stippled, larger than w3. Coxa II and femur II each with one tactile seta. Coxa II and femur III each with one tactile seta.

Terminal segments of females abdomen as in pl. 39, fig. 2. Pleurites lightly pigmented to margin: m4 dark brown. Chorion of ventral pleurites as in pl. 4; pleurites on pleurite IV all stippled. Antennal lappets twice as long as other two lappets. Valsa with 2 to 3 setae, average 4.5. Malar galea as in pl. 37, fig. 2. Margin of maxilla with medial blunt tip. Apex stout, each bearing three setae.

Dimensions.—Female (n = 8): total length 4.49-4.87 (4.60); greatest width 1.31-1.58 (1.47); head length 0.85-0.90 (0.88); head width 0.84-0.86 (0.85); head index 86-104 (91); labial width 0.36-0.40 (0.39); proboscis length 0.03-0.04 (0.03); mouthparts width 0.30-0.32 (0.31); distance between proboscises 0.38-0.44 (0.40); Malar (n = 2): TL, 3.67, 3.79; GW, 1.03-1.05; HW, 0.75, 0.77; LW, 0.74, 0.75; HW, 100, 102; LW, 0.33, 0.34; PL, 0.18, 0.19; PW, 0.04, 0.05; distance between proboscises 0.48-0.54 (0.49); width of genialia 0.20-0.21 (0.20).
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Ricinus communis has been recorded from the Snow Bunting, E. bombycilla (now E. fringilla) by Denny (1842); R. difussus (Kellogg) by Children (1836), and one specimen taken by Dr. P. D. Hurd, Jr., in Alaska; and the form considered herein as thoracicus. This form more closely resembles Packard's figure than the others recorded from P. trophonius nasicornis. Bolat (1952) referred to this form as R. thoracicus. Two other species superficially resemble R. thoracicus (as defined herein); R. inornatus Blagoveschensky and R. caracarii, n. sp. This situation appears to meet the "exceptional circumstances" requirement in the Code for designation of neotypes. Unfortunately none of the specimens examined herein is curated adequately enough to be designated as the neotype. In each specimen at least one diagnostic feature is obliterated or distorted. Designation of a neotype for R. thoracicus is withheld for the present pending receipt of specimens in good condition.

Ricasin inornatus Blagoveschensky, 1951


Description: —Head as in pl. 40, fig. 1; head as wide as long. Frontal carina arched medially; from rounded. Mandibles as in pl. 40, fig. 2. Labium with 14 pairs of setae, pattern as in pl. 40, fig. 5. Mental setae longer than maxillaries. Maxillary plate saucer-shaped, broader distally; palp genticulate, protruding past margin of head. Lateral and ventral nodi equal in size. Setae a1 as long as pa series. Setae a1 longer as a4; a1 each with two sensilli; anterior sensillum variable in its position relative to a1. Setae pol spinose; pol pilose, slightly longer than pol. Setae, v7, shorter than v1; pol pilose, all in size. Setae plate similarly. Setae as in pl. 40, fig. 1; number of setae 2 x 3 to 3 x 4, average 3 x 3. Setae and antennal lappets variable in number, 9 x 9 to 15 x 17, average 12 x 13.
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sternal plate with two pairs of long setae and one short pair posterior. Six setae in w seriæ; w plate. Setae q later than in other species of Rieinus. Setae c slightly longer than c. Cona I with two long tactile setae; femor 1 with three tactile setae. Cona II and femor 11 each with one tactile setae.

Terminal segments of female abdomen as in pl. 43, fig. 5. Pleurites not pigmented to margin. Oostegy of ventral pleurites as given in table 4; two long setae on each pleurite on segments IV-VIII. Setae on sternites II-VII as long as nvt. Hourglass-shaped golden markings on sternites II-VII. Male genitalia as in pl. 43, fig. 4. Margin of mesonotal rib; spinous cuticle, each with four setae.

Pigmentation pattern characteristic. Two distinct blotches on outer margins of sternal plate. Nodi of head, thorax, and pleurites, the carina of temples, labrum, and legs, and the male genitalia ochred in color.

Dimensions:—From Passerina spp. Females (n = 11): total length 3.56-4.55 (4.15); greater width 1.13-1.22 (1.19); head length 0.77-0.81 (0.79); head index 109-110 (109); lateral width 0.30-0.34 (0.32); prothoracic length 0.46-0.48 (0.46); prothoracic width 0.68-0.82 (0.76); distance between prosternae 79-89 (84). Male (n = 11): TL. 3.81; GW. 0.98; HL; 0.71; HW; 0.68; Hf; 1.05; LW. 0.29; PL. 0.35; PW. 0.06; distance between prosternae 82-96 (89). From Colopogon sp.: Females (n = 5): TL. 3.50-4.16 (4.08); GW. 0.81-0.99 (0.96); HW. 0.66-0.74 (0.66); distance between prosternae 72-91 (80).

Distribuion.—Known from three genera, Passerina, Guineus, and Cymopoma, in subfamily Richmondeninae, family Fruhstorferi.


Specimen Inqurement

Rieinus alphaeriopyrus Eichler, 1956

Rieinus alphaeriopyrus Eichler, 1956, in: Nematologica, 12: 17-34. Cona II and femor 11 each with three tactile setae. Cona 1 with two long tactile setae; femor 1 with three tactile setae. Cona II and femor 11 each with one tactile setae.

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Specimen Inqurement

Rieinus decipiens Eichler, 1956

Rieinus decipiens Eichler, 1956, in: Nematologica, 12: 17-34. Cona II and femor 11 each with three tactile setae. Cona 1 with two long tactile setae; femor 1 with three tactile setae. Cona II and femor 11 each with one tactile setae.

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species inquirendae. Eichler indicated that it was most similar to *R. frenatus* (Burmeister) and *R. expeditus* Eichler (now *R. tweediei* (Kellogg)). It was distinguished from these by the concave sides of the head produced by the broadened clypeus and expanded temples.

Carriker (1964) included *R. alpaphaenius* in his key, taking the differentiating characters from one female specimen collected from *Lessonia ruja ruja* in Portín Campero, Bolivia, on September 19, 1939. The head of this species has straight rather than concave sides, and the clypeus (= frons) and temples are not expanded. Therefore it is unlikely that the specimens of Eichler and Carriker are conspecific.

**Ricinus cherrieri** (Durrant, 1906)


Durrant (1906) described *Physostomum cherrieri* from seven specimens: four females from *Melocactus cabanisi* and two males and one female from *M. leucotis*. These specimens have not been located at Ohio State University, Cornell University, in the V. L. Kellogg collections, or in the collections of the U. S. National Museum. They are assumed to be lost.

Durrant compared *R. cherrieri* to *R. subanulatus* (Carriker) and *R. subhastatus* (Durrant). It resembles these species in general shape, but differed in markings, details of shape, and size. Although the description was long and figures were included, no good diagnostic characters were given. Therefore this species is designated as species inquirendae.

**Ricinus muscicriocloce* Eichler, 1956


Eichler (1956) described *R. muscicriocloce* from one male and one female specimen from *Muscicriocloce m. muscicriocloce*. Unfortunately his description gives no clues to its identification. It presents two characters which do not distinguish this species from other species of *Ricinus*. Also, it is compared with another species described in the same paper which is equally unidentifiable from the description given. I have not been able to obtain the types of this species. Until a clearer description and figures are presented, this species is considered species inquirendae.

**Ricinus proteetus** (Nitzsch, 1874)

*Physostomum proteetus* Nitzsch, 1874. In Giebel, Jenaer entom. 257; Fugger, 1880, Les Pediniolines, 608; Kellogg, 1908, Wytman’s Genera Insectorum, 66:72. *Ricinus proteetus* (Nitzsch). Harrington, 1919. Parasite, 9:67; Hopkins and Clay, 1952, Checklist of Mallophaga, 327. Type locality: *from a dried mouse skin in Berlin*. Type host: *Can- pygicus micianus* (now Diplogas baritula Wagner). *Physostomum proteetus* Nitzsch was published posthumously by Giebel (1874) from Nitzsch’s handwritten description. The type and only specimen was collected from *Canpygicus micianus* (now *Diplogas baritula* Wagner). The description was inadequate for identification and no figure was published. Furthermore, the type has been destroyed. Specimens are needed from the type host for identification and designation of a neotype. Dr. D. P. Furman attempted to obtain specimens from *Diplogas* in Venezuela, but found only egg cases, which are identified as belonging to *Ricinus*. At present this species must be considered related species inquirendae.

When specimens of *R. proteetus* are obtained, they should provide interesting data on the family position of *Diplogas*. *Diplogas* has been placed traditionally in Coerobiidae, but Beecher (1951) presented evidence that Coerobiidae was an artificial family. Genera included herein were specialized members of two families, Parulisidae and Thripidae, which have undergone similar morphological changes due to adaptation to a common mode of feeding. Beecher (1951) included *Diplogas* in Thripidae. If Mallophaga indeed can be used to indicate relationships of their hosts, then *R. proteetus* should show evidence that suggests support for either Beecher’s or the traditional family allocation of the genus *Diplogas*. At the species level, *Diplogas* is more closely related to *Thripus* than to *Diplogas*. *Ricinus* and *Diplogas* are both members of the family *Mallophagidae*, but *Diplogas* is more closely related to *Thripus* than to *Ricinus*. The type host of *R. proteetus* was a bird, and the type host of *Diplogas* was a mouse. *Ricinus* and *Diplogas* are both members of the family *Mallophagidae*, but *Diplogas* is more closely related to *Thripus* than to *Ricinus*. The type host of *R. proteetus* was a bird, and the type host of *Diplogas* was a mouse.

**Nomen dubium**

**Ricinus nigrolimbatus** (Müller, 1910)


Müller (1910) described this species from one female taken from *Spiloptera sp.* or *Calamochera sp.* in Jingelbrink on May 5, 1870, by Dr. Stixberg. Hopkins and Clay (1952) assumed that the correct host was probably *Anoplocnemis sp.* After examination of the type, Heineveld (1958) stated that he could not find any known
species in the Old World that compared with R. nigrofimbriatus, Dr. Kjellander of the Swedish Museum of Natural History kindly sent me the type.

The condition of this specimen, which is overlaid and distorted, is so poor that identification is not possible beyond placement in the marginatus species group. Since identification of the type and type host cannot be made, appeal will be submitted to the International Commission of Zoological Nomenclature for inclusion in the Official Index of Rejected and Invalid Names in Zoology as a nomen dubium.

HOST DISTRIBUTION LIST

The following host list includes only New World birds and two introduced Old World birds. The family classification follows Wetmore (1960). Nomenclature of the avian hosts follows that of the AOU checklist for North American birds (1957), the Mexican checklist for Central American birds (1957), and De Sclater (1866) for South American birds. Subspecific names are not included, since it is not possible to determine the correct subspecific names from geographical information on slide labels. Furthermore, there are no data available to support specific relationships of Ricius with subspecies of hosts. Nonspecific records and records considered to be of stragglers or contaminants are omitted.

When no asterisk occurs before the name of Ricius the host association of that species has been repeatedly confirmed by few to many collections. Names preceded by one asterisk (*) are from a single collection. Names preceded by two asterisks (**) are records of host association taken from the literature which have not been personally verified.

Order Passeriformes

Suborder Tyranni

Family Cotingidae

Myiarchus fuliginosus (Linnaeus, 1758) — Ricius marginatus

Myiarchus cinerascens (Giraud, 1839) — Ricius marginatus

Myiarchus fuliginosus (Linnaeus, 1766) — Ricius marginatus

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Species of Ricinus (Mallophaga: Amblycera) that are ectoparasites of passerine birds in the New World are revised. The genus occurs on members of 28 of the 70 families of Passeriformes. A relief distribution is indicated.

Little biological information is available for species of Ricinus. Rates of incidence and infestation usually are low, at least in California. Observations that are available indicate an apparent concordance in the reproductive seasons of the host and their hosts. "Preferred" ovipositional sites are demonstrated. Hematophagia as an exclusive method of feeding is strongly suggested by the feeding habits, with the presence of blood in the gut. An investigation of the zoone role of species of Ricinus is needed.

A historical review of the extreme confusion that has surrounded the status of the name Ricinus and that of its type species R. fringillae is presented. Their status is now fixed and accepted through the declaration of Opinion 627 by the International Commission of Zoological Nomenclature.

The external morphology of the species of Ricinus s. described with emphasis on the salient features used in defining and recognizing species. A system of chelateotaxy is erected. Measurements of various structures are of little use in defining species because of presence of much intraspecie variation and apparent host-induced variation. Characters found to have diagnostic value are the shape of structures, the pigmentation pattern, and the chelateotaxy. A species is defined on the basis of multiple characters.

A hypothetical phylogeny is proposed for the genus Ricinus and its species, based upon modifications of several structures found on extant forms. Changes in the structure of the labium, labrum, mandible, tergum, and thorax among other demonstrative the Ricinus is a specialized genus in the suborder Amblycera. Specializations exhibited within the genus indicate that Ricinus has undergone two separate radiations, interspersed by a period of decline.

The genus is redescribed and divided into eight species groups. Thirty-eight species are considered valid. Twenty-five specific and subspecies names are used as synonyms. Five names are designated species inquirendae. Ricinus nigrolineatus (Mjoberg, 1910) is designated nomine dubium. Twenty-four species are redescribed, of which four, R. arcturus, R. fringillae, R. marginatus, and R. cucuina are given genus status. Fourteen new species are described: R. carolinus, R. carolynae, R. dalpechi, R. desorci, R. eremanri, R. mandubialis, R. naparchi, R. sevieri, R. sitae, R. subdiffusus, R. vireonensis, R. volatinae, and R. wolfi.
Certain species of *Ricinus* show host specificity at the specific, generic, and family level. Certain species groups show host specificity at the family, superfamily, or subordinal level. These forms are found useful in deducing probable host phylogeny. Other species and species groups are distributed so anomalously that no correlation is apparent between the evolution of the line and their hosts.

It is proposed that secondary transfer have occurred, obscuring any phyllogenetic relationship. The potential for and occurrence of secondary transfer are discussed and shown to be more common than previously realized. A seemingly anomalous distribution of a host on two or more species of host probably indicates an ecological relationship for the hosts involved.

Several cases are resolved in which two and, rarely, three species of *Ricinus* regularly occur on the same host species. This synoxenic distribution follows no geographical or taxonomic pattern.

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drew the figures of the patterns on the ovoid sclerites. Mr. J. Burger, Mr. J. Maltkoff, and Mr. P. Rubtzko translated publications and correspondence in Russian and Czecho-Slovakian. To Miss Catherine A. Stadler, Miss Judith Hammond, and Mrs. D. Morgan I am indebted for proficiency in typing.

My wife, Carolyn, helped me throughout the study, spending much time in the field and in the typing of the rough drafts. Her constant encouragement and unfailing devotion were of major importance in the completion of this study.

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INDEX

Only nominal taxa of the Mallophaga are included. Names of lines given in the distribution list (beginning on p. 112 and following) are omitted. Inclusion in keys is indicated by page numbers in italics.
PLATES

Each plate is accompanied by a detailed legend. Figures of the head and terminal segments of females are dorsal cranial views. Figures of the thorax are ventrodorsal views. The abbreviations and series of chaetotaxy are given below. The plate and figure following each abbreviation or series of acme indicate where that structure or series is first labeled.

ABBREVIATIONS

ant. lab. anterior labrum
ant. lag. anterior lappet
ant. n. antenna
t. b. p. tergite, pleuron, pl. d. p. gut, pl. lab. labrum
tm. n. tergite, n. tr. ant. terminal antennal seta
v. sp. vulval seta
vul. vulva

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SERIES OF SETAE

a series ........................................ pl. 2, fig. 1  
b series ........................................ pl. 3, fig. 1  
c series ........................................ pl. 3, fig. 1  
d series ........................................ pl. 2, fig. 1  
e series ........................................ pl. 2, fig. 1  
f series ........................................ pl. 2, fig. 1  
L series ........................................ pl. 3, fig. 1  
m series ........................................ pl. 2, fig. 1  
p series ........................................ pl. 2, fig. 1  
qu series ...................................... pl. 3, fig. 1  
t series ........................................ pl. 2, fig. 1  
w series ........................................ pl. 3, fig. 1

PLATES
Pl. 1. Dendrogram showing proposed hypothetical phylogeny of species of Ricinus occurring in the New World.
Pl. 5. *Bicissa* ornatus (Kellington and Mann). Fig. 1, terminal segments of female abdomen. Fig. 2, male genitalia. *K. myriacantha* n. sp. Fig. 3, terminal segments of female abdomen. Fig. 4, male genitalia.
Pl. 7. Riepus leptogrammus (Cerker). Fig. 1, labium. Fig. 2, male genitalia. Fig. 3, head. Fig. 4, terminal segments of female abdomen. Fig. 5, thorax. Fig. 6, mandibles (left mandible above; right mandible below).
Pl. 8, *Ricinus arenarius* (Kolbog). Fig. 1, male genitalia, Fig. 2, head, Fig. 3, mandibles (left mandible above, right mandible below), Fig. 4, labium, Fig. 5, terminal segments of female abdomen, Fig. 6, thorax.
Pl. 10. *Eutoma tridentata* DeGeer. Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, terminal segments of female abdomen. Fig. 5, thorax.

Pl. 11. *Eutoma japonica* (Erich). Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles (left and right mandibles are reversed). Fig. 4, male genitalia. Fig. 5, terminal segments of female abdomen. Fig. 6, thorax.
Pl. 12. *Ricinae macrophthalmus* (Kellogg). Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, terminal segments of female abdomen. Fig. 5, thorax.
Pl. 16. *Eriesea serrata* (Durrant). Fig. 1, head. Fig. 2, mandibles and pattern on oviduct. Fig. 3, labium. Fig. 4, thorax. Fig. 5, male genitalia.

Pl. 17. *Eriesea ficta* Corrie. Fig. 1, head. Fig. 2, terminal segments of female abdomen. Fig. 3, mandibles. Fig. 4, thorax. *Eriesea serrata* (Durrant). Fig. 5, terminal segments of female abdomen.
Pl. 20. *Eccius pallescens* Cresson. Fig. 1, head. Fig. 2, mandibles. Fig. 3, labium. Fig. 4, terminal segments of female abdomen. Fig. 5, thorax.

Pl. 21. *Eccius pallens* (Kellogg). Fig. 1, head. Fig. 2, male genitalia. Fig. 3, labium. Fig. 4, mandibles. Fig. 5, terminal segments of female abdomen. Fig. 6, thorax.
Pl. 22. *Ricinus salubris* n. sp. Fig. 1, head. Fig. 2, mandibles. Fig. 3, labium. Fig. 4, thorax. Fig. 5, terminal segments of female abdomen.

Pl. 23. *Ricinus pictus* (Curcile). Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, male genitalia. Fig. 5, terminal segments of female abdomen. Fig. 6, thorax.
Pl. 24. *Ricinus* externe n. sp. Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, male genitalia. Fig. 5, thorax. Fig. 6, terminal segments of female abdomen.

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Pl. 25. *Ricinus* dendroica n. sp. Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, male genitalia. Fig. 5, thorax. Fig. 6, terminal segments of female abdomen.
Pl. 26. *Resecia abbreviata* sp. Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, male genitalia. Fig. 5, thorax. Fig. 6, terminal segments of female abdomen.

Pl. 27. *Resecia abbreviata* (Carrière). Fig. 1, head. Fig. 2, mandibles and pattern of ovoid sclerites. Fig. 3, labium. Fig. 4, male genitalia. Fig. 5, terminal segments of female abdomen. Fig. 6, thorax.
Pl. 30. Rictus compuncto Carriker. Fig. 1, head. Fig. 2, mandibles. Fig. 3, labium. Fig. 4, thorax. Rictus subangulatus (Carriker). Fig. 5, thorax.

Pl. 31. Rictus ramsayi n. sp. Fig. 1, head. Fig. 2, mandibles and fused oral sclerites. Fig. 3, male genitalia. Fig. 4, thorax. Fig. 5, labium.
Pl. 32. *Eriusus* rotundus n. sp. Fig. 1, head. Fig. 2, terminal segments of female abdomen. Fig. 3, mandibles and ovoid sclerite. Fig. 4, labium. Fig. 5, terminal segments of female abdomen.

Pl. 33. *Eriusus* ricanus n. sp. Fig. 1, head. Fig. 2, labium. Fig. 3, male genitalia. Fig. 4, thorax. Fig. 5, maxillae. Fig. 6, pattern of ovoid sclerite.
Pl. 34. *Ricinus subdilatatus* n. sp. Fig. 1, head; Fig. 2, mandibles; Fig. 3, labium; Fig. 4, male genitalia. Fig. 5, thorax; Fig. 6, terminal segments of female abdomen.

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Pl. 35. *Ricinus sibiricus* n. sp. Fig. 1, head; Fig. 2, labium; Fig. 3, mandibles; Fig. 4, thorax. Fig. 5, male genitalia. *R. deltagis* (Kohlig). Fig. 6, terminal segments of female abdomen.

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Pl. 37. *Keita* calcarri n. sp. Fig. 1, head. Fig. 2, labium. Fig. 3, male genitalia. Fig. 4, thorax. Fig. 5, mandibles.

Pl. 36. *Koelensia diffusa* (Keellson). Fig. 1, head. Fig. 2, male genitalia. Fig. 3, thorax. Fig. 4, mandibles. Fig. 5, labium.
Pl. 28. Erioxus thoracicus (Packard). Fig. 1, head. Fig. 2, labium. Fig. 3, male genitalia. Fig. 4, thorax. Fig. 5, mandible.

Pl. 29. Reona calcaria n. sp. Fig. 1, terminal segments of female abdomen. Fig. 2, terminal segments of female abdomen.
Pl. 46. Ricinus (rupeci Hingopez et al.), fig. 1, head; fig. 2, male genitalia; fig. 3, mandibles; fig. 4, thorax; fig. 5, abdomen.

Pl. 47. Ricinus enophaeus, fig. 1, head; fig. 2, labium; fig. 3, mandibles and ovoid sclerites; fig. 4, male genitalia; fig. 5, thorax; fig. 6, abdomen.
Pl. 42. *Ricinus communis* Bl. 

Fig. 1. Terminal segments of female abdomen. *R. olearius* n. sp. Fig. 2. Terminal segments of female abdomen.

Fig. 3. *Ricinus communis* (Kellogg). Fig. 1, head. Fig. 2, labium. Fig. 3, mandibles. Fig. 4, male genitalia. Fig. 5, terminal segments of female abdomen.