

## AN ANNOTATED LIST OF THE BLOODSUCKING INSECTS, TICKS AND MITES KNOWN FROM PANAMA

G. B. FAIRCHILD

*Medical Entomologist, Gorgas Memorial Laboratory, Panama, R. de P.*

Received for publication June 3, 1943

The need for some sort of reference list of the insects of potential medical importance occurring in Panama was brought rather forcibly to the attention of the writer last year. During attempts to prepare a simple account of the more important biting and annoying insects found in Panama for the use of entomologically untrained Army personnel, it became apparent that a summing up of the information gathered by the writer and his predecessors in this rich area had become a real necessity. Medical entomologists are somewhat anomalous creatures at best, being either medical men who have taken up entomology through force of circumstances, or entomologists who have become interested in some group of insects of medical importance. There is no journal entirely devoted to medical entomology, and articles on the subject are published wherever the author thinks he can reach the most interested audience. This makes it necessary for workers in this field to attempt to keep up with both the medical and entomological literature, a task that is all but impossible except to the fortunate few within reach of a really adequate library. Anyone interested, for example, in the entomological aspects of malaria, may find important papers tucked away in journals devoted to hygiene, parasitology, ecology and immunology, as well as in a host of more or less obscure medical and entomological periodicals.

The present list is, then, an attempt to gather together in one place the information available on the bloodsucking insects other than mosquitoes, but including ticks and mites, which are known to occur in the Republic of Panama. The myiasis-producing flies, although not truly haematophagous, have also been included. The list is primarily for the use of medical entomologists, and the entomological features are therefore given first place. Brief mention is made, where necessary, of the medical importance of the various species, and reference is made to the more important work done in Panama on insect-borne diseases.

Although Panama and the Canal Zone have been a happy-hunting-ground for entomologists, medical and otherwise, for a generation, the gaps in our knowledge of the potential disease vectors to be found here are still very extensive. Such important groups as the fleas, the sandflies and the mites have hardly been touched. What information we have has mostly been the result of chance encounters by entomologists looking for something else, or of work done at odd moments stolen from other investigations. Much valuable information is also doubtless stored away in the minds and collections of the many entomologists who have worked on the Isthmus from time to time, but who have lacked the time or the interest to publish their findings.

Major Lawrence H. Dunn, for many years entomologist to the Board of Health

Laboratory, Ancon, Canal Zone, and from 1929 to 1934 entomologist and assistant director of the Gorgas Memorial Laboratory, has contributed more than all others together to our knowledge of Isthmian medical entomology. Probably two-thirds of the species recorded in this list were first reported by him, or the records are based on his material. Mr. James Zetek has for the past twenty years been keeping records of both the fauna and flora of Barro Colorado Island, and he has kindly allowed the writer access to his files, from which records of a number of species have been secured. The author's own collecting, and specimens sent to the laboratory for identification, as well as small collections made by numerous friends make up the rest of the material studied.

Of the groups treated it is felt that, as far as published information goes, lists of the *Tabanidae*, *Simuliidae*, *Ixodoidea*, *Hemiptera*, *Siphonaptera*, *Psychodidae*, *Muscidae* and *Ceratopogonidae* approach completeness. The lists of *Anophora*, the mites, and the myiasis-producing Diptera are admittedly not complete, due largely to lack of literature, but all of the more important species are believed to be included. The *Tabanidae* and *Simuliidae* have been the subjects of recently published papers by the present writer (1940, 1942) and for the sake of completeness are merely listed here. The writer is much indebted to Prof. R. A. Cooley for determinations of some of the ticks, and to Dr. H. G. Barber of the U. S. National Museum for determinations of the bloodsucking bugs. All other determinations not taken from the literature were made by the writer.

The mosquitoes have been omitted; although Dyar's list (1925) is sadly in need of revision, the present writer feels that it would be highly presumptuous for him to attempt to do what far better culicidologists have refrained from doing. The *Mallophaga* or bird-lice have been omitted because it was felt that they were not likely to be of interest from a medical point of view, and because practically no literature was available here on this very extensive group. The *Pupipara* are omitted because there is in process of publication by Dr. J. Bequaert a complete list of the species so far known from Panama and Colombia.

#### *Psychodidae*—Sandflies, moth-midges, "chitra"

The biting members of this family in Panama all belong to the genus *Phlebotomus*, and although the genus has been variously divided into quite a number of subgenera, mostly on the basis of characters of the male terminalia, not enough is known of the Panama species to warrant listing them further than as *Phlebotomus*.

Next to mosquitoes and ticks, these small flies are perhaps the most important arthropod vectors of human disease, and although they are not uncommon here, the diseases they transmit appear to be rather rare in Panama. In the Old World species of the genus are vectors of Kala-Azar and Oriental sore, caused by species of *Leishmania*, and of Papataci fever, a dengue-like fever caused by a virus. In addition, an intense allergic skin reaction known as Harara is elicited in sensitive subjects by the bites of *Phlebotomus*. In the new world, *Phlebotomus* of several species have been incriminated as vectors of American Leishmaniasis, the cutaneous form of which occurs occasionally in Panama (Darling, 1911). In addition, certain species are the vectors of *Bartonella bacilliformis*, the causative

agent of Oroya fever and Verruga peruana or Carrion's disease in Peru. This disease has recently appeared in Colombia and Ecuador, and threatens to become a major public health problem. The bite of *Phlebotomus* is exceedingly painful, and often leaves a burning wheal lasting several hours. In Panama these flies are known as "chitra."

Since the larvae live in moist soil, in caves, rock crevices, etc., control measures directed against the early stages would not seem very practicable, and little research on such measures appears to have been done. Screening to be effective must be of much finer mesh than that used against mosquitoes, and under most circumstances would be prohibitive in cost. Some of the newer repellents promise to be fairly effective for limited protection.

Four species are recorded as occurring in Panama, and I have limited material of at least two other as yet undescribed forms. Females are difficult to distinguish, and as most species have been founded on males, without associated females, identification of females caught biting is often impossible. The described Panama species are listed below:

*Phlebotomus shannoni* Dyar 1929. Described from Gatun, C. Z., and apparently not taken since. The females are indistinguishable from those of *cruciatu*s and *suis* on the basis of published descriptions.

*Phlebotomus cruciatu*s Coquillett 1907. Described from females only from Guatemala. Dyar (1929) records males and females from Gatun, C. Z.

*Phlebotomus suis* Rozeboom 1940. Three males and a long series of females which agree with the description have been taken in the vicinity of the type locality in the Chagres River valley.

*Phlebotomus panamensis* Shannon 1926. Root (1934) has carefully figured and described this species, which is recognizable in the female by the structure of the palpi and spermathecae. The species has been taken at Juan Mina, on the upper Chagres River, and on the upper Bayano River. No males have been seen.

Males of two other species have been taken in a light trap at Juan Mina, in the Chagres River valley. One of these, represented by one from Juan Mina and two from Darien, seems related to *Ph. (Viannamyia) furcatus* Mangabeira, while the other is close to *Ph. (Psychodopygus) geniculatus* Mang. Of females, some 60 odd specimens have been studied, which fall into two groups on the basis of the structure of the palpi. Those with a short fifth palpal segment all seem to be *panamensis* Shann., as the structure of the spermatheca shows. Those with a long fifth palpal segment fall into two distinct groups, one of which, represented by two specimens, has spermathecae somewhat like those figured for *Ph. triacanthus* Mangabeira. The rest have spermathecae agreeing in general with those figured by Rozeboom in his description of *Ph. suis*.

*Phlebotomus* seem to be fairly abundant and widespread in Panama, but only rarely do they occur in sufficient numbers to cause real discomfort. At Juan Mina, on the Chagres River, occasional specimens entered the house, and a number were taken in a mosquito light trap. On Chepillo Island, off the mouth of the Bayano River, they were quite abundant, entering houses freely to bite. I

have also taken occasional specimens in houses in and about Panama City, and have received specimens, taken in the act of biting by others, from Agua Clara on the Rio Bayano, and from several localities in Darien province.

*Ceratopogonidae*—midges, punkies, "jejenes", "plagas"

Very little work has been published on these small biting midges in Panama, and but 6 species of two genera are reported as occurring here (Hoffman 1925; Dunn 1934). Many more will undoubtedly be found whenever anyone with an interest in the group takes the trouble to collect them systematically. Material on hand taken in light traps at Juan Mina on the Chagres River below Madden Dam shows the presence of many additional species.

Mr. James Zetek has collected considerable material of this group at light on Barro Colorado Island, some of which has been determined by Drs. Alan Stone and H. K. Townes of the U. S. National Museum. Mr. Zetek has kindly allowed me to incorporate this information in the present list.

Species of *Culicoides* are known to be carriers of several human and animal parasites. Buckley (1934) has shown that *Culicoides furens* acts as the intermediate host of *Mansonella ozzardi*, a non-pathogenic filarial blood parasite of man. Both the filaria and its vector occur in Panama (McCoy, 1933). In Africa, Sharp, (1928) has incriminated *Culicoides austeni* and *C. grahmi* as vectors of *Acanthocheilonema perstans*, another nearly non-pathogenic human filaria. *A. perstans* is also recorded from the northern and eastern parts of South America, but its vectors there remain to be studied. In England, Steward (1934) found that *Onchocerca cervicalis*, the cause of fistulous withers in horses, used *Culicoides nubeculosus* as an intermediate host. According to Huff (1938), George has found that *Culicoides furens* is also the vector of *Tetrapetalonema marmosetae*, a filarial parasite of certain monkeys in Panama.

Although as disease vectors these small flies are of very minor importance, they may become a major nuisance problem at times. Where abundant, and they may occur in veritable clouds, they can make life unbearable to man and animals alike, the pain from the bite being out of all proportion to the size of the insect. Screens and bed nets are usually of little help, as the minute size of the flies allows them to pass freely through all but the finest meshes. Some of the newer repellents being developed against mosquitoes seem to be equally effective against them, but where economic considerations warrant the expenditure and where the species involved has accessible breeding haunts, the destruction of its breeding areas affords the only permanent relief (Bequaert, 1924; Painter, 1926).

The following list includes those species recorded from Panama by Hoffman and Dunn, and the additional material taken by Zetek on Barro Colorado Is. The latter species are followed by (B. C. I.):

*Culicoides diabolicus* Hoffman, Cabima, Panama (also B. C. I.).

*Culicoides furens* Poey, Gatun, C. Z.

*Culicoides loughnani* var *jamaicensis* Hoffman. Ancon, C. Z.

*Culicoides fluviatilis* Lutz Chiriqui, Panama.

*Culicoides paraensis* Goeldi Chiriqui, Panama.

*Lasiohelea* sp. "prob. *stylifer* Lutz" Chiriqui, Panama.

*Atrichopogon*, 3 spp. (B. C. I.).

*Bezzia* sp. (B. C. I.).

*Ceratopogon flavus* (B. C. I.).

*Dasyhelea* sp. (B. C. I.).

*Forcipomyia raleighi* (B. C. I.).

*Forcipomyia flava* (B. C. I.).

*Forcipomyia* 3 spp. (B. C. I.).

*Probezzia* sp. (B. C. I.).

*Sphaeromyia* sp. (B. C. I.).

*C. furens* seems to be the most annoying species here. It breeds in the vicinity of mangrove swamps and other salt or brackish coastal swamps, and has caused much annoyance, particularly on the Atlantic side of the Isthmus. These insects are known as "sand flies", "punkies," or "no-sec-ums" in North America, while the name used in Panama is "jejenes" or "plagas."

#### *Simuliidae*—black flies, "rodedores"

The writer (Fairchild 1940) has discussed the species occurring in Panama at some length. Subsequent work has, however, necessitated a few changes in nomenclature which are embodied in the subjoined list.

These small flies are not particularly numerous in Panama, being rather local in distribution, and only abundant at certain seasons. The early stages are passed in running water, the larvae attaching themselves to rocks, water weeds, and vegetation trailing in the water. The bites of those species which attack man are very annoying, as they may itch intensely for several days, and the consequent scratching makes them unusually liable to secondary infection. Figures and an excellent discussion of the effects of the bites of these insects are given by Strong et al. (1926) in their report on their expedition to the Amazon. Several species of *Simulium* are the known vectors of *Onchocerca volvulus* in parts of Central America and in Africa (Strong et al. 1934; Blacklock 1926). In Central America the disease is so far limited to certain highland areas of western Guatemala and the adjoining Mexican states of Chiapas and Oaxaca. Mexican students are concerned at the gradual spread of the disease, and Lorenzana (1940) has summarized the knowledge of the disease in Chiapas and proposed a program for control and eventual eradication. Onchocerciasis is not known elsewhere in the western hemisphere, but proven and possible vectors are widely distributed.

*Simulium sanguineum* Knab. Listed by the writer as probably occurring in Panama. Smart (1940) has listed specimens from Darien Province, and the writer has since seen material from El Real and Yape in Darien.

*Simulium samboni* Jennings.

*Simulium panamense* Fairchild.

*Simulium ochraceum* Walker.

*Simulium mexicanum* Bellardi.

*Simulium clarki* Fairchild.

*Simulium metallicum* Bellardi.

*Simulium quadrivittatum* Loew. The identity of this species is uncertain. The writer listed it as *haematopotum* Mall., with some doubt, but through the

courtesy of Dr. A Dampf he has since seen true *haematopotum*. Vargas (1942) renamed the species *fairchildi*, but it is perhaps better to return to Loew's name until Cuban material can be compared.

*Simulium marathrumi* Fairchild.

*Simulium pulverulentum* Knab.

*Simulium virgatum* Coquillett.

*Tabanidae*—horse flies and deer flies, "tábanos"

The writer has recently summarized his own and previous work on this group (Fairchild 1942), and as the family is of slight medical importance, the 89 species are merely listed here. Horse flies are abundant in many parts of the Republic, and at certain seasons constitute a serious stock pest. Although they are not known definitely to transmit any disease in Panama, they are proven carriers of a number of diseases in other parts of the world. Tularaemia (Francis and Mayne 1922), surra (Mitzmain 1913), rinderpest (Kapur 1941), bovine anaplasmosis (Lotze and Yiengst 1941), equine infectious anaemia (Stein, Lotze and Mott 1942), *Loa loa* (Connal and Connall 1922) and probably a number of other diseases are capable of transmission by these flies. Except in the case of *Loa loa*, which is a filarial parasite of man, transmission seems to be nearly always purely mechanical. The annoyance caused to stock may be at times serious, and the wounds caused by the larger species often provide a port of entry for the screw worm fly (*Cochliomyia hominivorax*).

*Chrysops alleni* Fchld.

*Chrysops calogastra* Schin.

*Chrysops chiriquensis* Fchld.

*Chrysops incisa* Macq.

*Chrysops melaena* Hine.

*Chrysops mexicana* Kröb.

*Chrysops soror* Kröb.

*Chrysops variegata* (de Geer).

*Esenbeckia chagresensis* Fchld.

*Esenbeckia illota osornoi* Fchld.

*Esenbeckia prasiniventris* (Macq.).

*Esenbeckia translucens* (Macq.).

*Fidena fulvosericca* Kröb.

*Fidena gracilis* Kröb.

*Fidena howardi* Fchld.

*Fidena isthmiae* Fchld.

*Fidena pyrausta* (O. S.).

*Pityocera festae* Giglio-Tos.

*Scione aureopygia* Fchld.

*Scione claripennis* Ric.

*Scione maculipennis* (Schin.).

*Dichelacera* (*Dichelacera*) *analís* Hine.

*Dichelacera* (*Dichelacera*) *marginata* Macq.

- Dichelacera (Dichelacera) regina* Fchld.  
*Dichelacera (Psalidia) fulminea* Hine.  
*Dichelacera (Catachlorops) transposita* (Walk.).  
*Diadlocera badia* Kröb.  
*Stibasoma apicimacula* Fchld.  
*Stibasoma chionostigma* (O. S.).  
*Stibasoma fulvohirtum* (Wied.).  
*Stibasoma theotaenia panamensis* Curr.  
*Stibasoma venenata* (O. S.).  
*Cryptotylus limonus* (Towns.).  
*Cryptotylus luteoflavus* (Bell.).  
*Cryptotylus unicolor* (Wied.).  
*Chlorotabanus inanis* (Fab.).  
*Chlorotabanus mexicanus* (Linn.).  
*Lepiselaga crassipes* (Wied.).  
*Selasoma tibiale* (Fab.).  
*Bolbodinomyia erythrocephala* (Bigot).  
*Diachlorus curvipes* (Fab.).  
*Diachlorus jobbinsi* Fchld.  
*Stenotabanus (Stenotabanus) calvitius* Fchld.  
*Stenotabanus (Stenotabanus) constabulorum* Fchld.  
*Stenotabanus (Stenotabanus) fulvistriatus* (Hine).  
*Stenotabanus (Stenotabanus) jaculator* Fchld.  
*Stenotabanus (Stenotabanus) lerida* Fchld.  
*Stenotabanus (Stenotabanus) maculifrons* (Hine).  
*Stenotabanus (Stenotabanus) minusculus* (Kröb.).  
*Stenotabanus (Stenotabanus) pequentiensis* Fchld.  
*Stenotabanus (Stenotabanus) plenus* (Hine).  
*(Aegialomyia) changuinolae* Fchld.  
*(Aegialomyia) paitillensis* Fchld.  
*(Brachytabanus) longipennis* Kröb.  
*Leucotabanus canithorax* Fchld.  
*Leucotabanus flavinotum* (Kröb.).  
*Leucotabanus leucaspis* (Wied.).  
*Tabanus (Tabanus) bigoti* Bell.  
*Tabanus (Tabanus) erebus* O. S.  
*Tabanus (Tabanus) ferrifer* Walk.  
*Tabanus (Tabanus) globulicallosus* Kröb.  
*Tabanus (Tabanus) importunus* Wied.  
*Tabanus (Tabanus) nereus* Fchld.  
*Tabanus (Tabanus) praepilatus* Fchld.  
*Tabanus rhizophorae* Fchld.  
*Tabanus (Tabanus) rixator* Fchld.  
*Tabanus (Tabanus) umbraticolus* Fchld.  
*Tabanus (Bellardia) albocirculus* Hine.

- Tabanus (Bellardia) de-filippii* Bell.  
*Tabanus (Bellardia) piraticus* Fehld.  
*Tabanus (Bellardia) pseudoculus* Fehld.  
*Tabanus (Bellardia) oculus* Walk.  
*Tabanus (Hybomitra) quadripunctatus* Fab.  
*Tabanus (Neotabanus) angustivitta* Kröb.  
*Tabanus (Neotabanus) amplifrons* Kröb.  
*Tabanus (Neotabanus) dunni* Fehld.  
*Tabanus (Neotabanus) enanus* Fehld.  
*Tabanus (Neotabanus) fumatipennis* Kröb.  
*Tabanus (Neotabanus) lineola* Fab. (3 varieties).  
*Tabanus (Neotabanus) maya* Beq.  
*Tabanus (Neotabanus) unistriatus* Hine.  
*Tabanus (Neotabanus) vittiger* var. *guatemalanus* Hine.  
*Tabanus (Philipotabanus) chrysothrix* Fehld.  
*Tabanus (Philipotabanus) ebrius* O. S.  
*Tabanus (Philipotabanus) elviae* Fehld.  
*Tabanus (Philipotabanus) magnificus* Kröb.  
*Tabanus (Philipotabanus) medius* Kröb.  
*Tabanus (Philipotabanus) pallidetinctus* Kröb.  
*Tabanus (Philipotabanus) pterographicus* Fehld.

#### *Biting muscids*

True haematophagous flies belonging to the family *Muscidae* are largely of old-world origin, only the genus *Neivamyia* being strictly Neotropical. In Panama only *Stomoxys calcitrans*, the stable fly, and *Lyperosia irritans*, the horn fly, have so far been taken, though species of *Neivamyia* may be expected to occur.

*Stomoxys calcitrans* (Linn.). Very common throughout the Republic, attacking horses, cattle and dogs freely, but very rarely man. It has recently been incriminated as a vector of equine infectious anaemia in the United States (Stein et al. 1942).

*Lyperosia irritans* (Linn.). This species first attracted the attention of cattlemen about 4 or 5 years ago, when it is reported to have been first noticed as a cattle pest in the region about Santiago in Veraguas province. Since then it has spread east at least as far as Pacora, about 20 miles east of Panama City. It is believed to have been imported with cattle from Colombia, and both its time of introduction and subsequent spread are roughly correlated with the appearance and spread of a serious trypanosomal disease of cattle (Johnson 1941). Attempts to secure naturally infected flies have so far failed, but *Lyperosia* should be looked upon with grave suspicion as a very likely vector.

#### *Myiasis-producing flies, "gusanos"*

Infestations with the larvae of various species of flies have been reported from time to time in the literature, and several extensive papers on the subject are available. In Panama, the great majority of such cases, both in man and



animals, are due to two species, the screw-worm fly and the so-called human bot-fly. Both have been the subjects of considerable investigation, and the literature is very extensive, the papers of Dunn (1919, 1930, 1934), applying particularly to Panama. Other species of flies no doubt cause myiasis here occasionally, and larvae passed in stools or extracted from body orifices have been sent to the laboratory for identification several times. Definitive identification has not been attempted, but in no case seen by me was it felt that the larvae were other than accidental inhabitants of the alimentary or genito-urinary tract.

*Cochliomyia hominivorax* Coquerel (*americana* C. and P.). The screw-worm fly has been the subject of a rather extensive paper by Dunn (1919) who found it common and widely distributed in Panama. Cases of human myiasis are cited, and losses caused by its depredations among livestock are estimated to be considerable. It must be noted, however, that Dunn did not discriminate between *C. macellaria*, a carrion feeder or secondary invader, and *C. hominivorax*, a true primary parasite, as the distinctions between the two species were not understood at that time. (Aubertin and Buxton 1934; Cushing and Hall 1937). Excellent illustrations of both species are given by Mazza and Jörg (1939).

*Dermatobia hominis* Say (*cyaniventris* Macq.). The so-called human bot-fly is by no means limited to man as a host, and would certainly become extinct were it so limited. Cattle appear to be the favored host where available, but the recorded host list includes a wide variety of mammals and even a few birds. For some unknown reason horses and mules are very rarely attacked. There are a number of other as yet unexplained facts in the life history of this species, and a comprehensive study is long overdue. In Panama the species is locally distributed, and its abundance varies widely from year to year. Some areas may remain comparatively free of infestation, while in others cattle raising is rendered practically impossible. Human infestation is fairly common in those who travel or hunt in the jungle. Dunn (1930, 1934) has summarized the information on the species as far as Panama is concerned.

*Mydaea pici* Macquart. This fly appears to be a common parasite of nestling birds. The larvae live beneath the skin, but emerge and pupate in a froth like cocoon made in the nest before the nestlings fly. A nest of the blue-black grassquit (*Volatinia jacarini atronitens*) containing two young yielded 5 pupae from which 2 males and 3 females emerged. Lutz and Neiva (1912) have discussed the occurrence of the species in Brazil.

*Cuterebra baeri* Shannon and Greene. This species is a common parasite of the howler monkey (*Alouatta palliata inconsonans*) in Panama, as noted by Goldman in his "Mammals of Panama" (1920, p. 229). It was described from specimens from Darien and British Guiana (Shannon and Greene, 1926). Dunn (1934a) also records the species from Chiriqui province.

*Cuterebra maculosa* Knab. This species was described in 1914 from captured specimens taken in Ancon and Cristobal, and nothing is known of its life history.

*Cuterebra analis* Macquart. This record is based on a specimen from the

Volcan de Chiriqui determined by Brauer and recorded by Van der Wulp (1888).

*Gastrophilus nasalis* Linn. Dunn (1934a) records the species from the stomach of a horse autopsied at Progreso, Chiriqui province. *G. haemorrhoidalis* would seem to occur here also, as although I have seen no material, there is a reference to specimens collected at Esperanza, Chiriqui, from a mule, among notes left by Dunn at this laboratory. Dr. H. C. Clark has informed me that of the several hundred horses and mules he has autopsied here, only two or three have carried bots, and only the one recorded by Dunn was certainly born in Panama. Imported horses often have bots, but those expelled in the faeces here always fail to mature. Dr. Clark has also told me that previous to 1917 he had the opportunity of examining a considerable number of deer killed locally, and that he estimates that about 20% were infested with bots in the pharynx. The specimens and records were all destroyed during his absence on duty in the last war. These were very likely some species of *Cephenomyia*, but no opportunity to examine deer has presented itself in recent years, and a definite determination must await further material.

#### *Hemiptera*

Blood-sucking bugs of two families, the *Reduviidae* and *Cimicidae*, occur in Panama. To the former belong a number of large species known as cone-nosed bugs or kissing-bugs in English, and "chinchas de monte" in Spanish. The *Cimicidae* includes the bed-bug or "chinchá" and a number of other forms parasitic on bats and birds which are so far not known from Panama.

The cone-nosed bugs have assumed considerable importance in recent years as vectors of Chagas' disease, or American Trypanosomiasis, and Neiva and Lent (1941) have listed the known species and those known to be vectors. A number of small mammals such as armadillos and opossums appear to act as reservoirs of the trypanosomes, and as the normal hosts for many of the bugs, while a few species have adapted themselves to conditions in human habitations of the more primitive sort, where they readily feed on the inhabitants. The bugs are large, able to fly, and occasionally attracted to lights, although as a rule they have much the same habits as bed-bugs, hiding in cracks, under furniture and in the thatched roofs of native houses, whence they sally forth at night to bite. Rozeboom (1936) has summarized the work done with these insects in connection with Chagas' disease in Panama, while Clark and Dunn (1932), Johnson and de Rivas (1936 and 1936a) and Johnson and Kelsner (1937) have summarized the human cases and animal reservoirs and reported a survey to determine the distribution of the disease in Panama. The disease appears to be fairly generally distributed throughout the Republic, but clinical cases are rare and almost always in young children. Transmission is now generally believed to take place by soiling of the site of the bite by the dejecta of the bug, or the rubbing of dejecta into the conjunctiva, rather than by the bite of the bug itself.

Bed-bugs are unpleasantly common throughout Panama. Experimentally they

have been shown capable of acting as vectors of several diseases, but are not considered of much importance epidemiologically.

*Panstrongylus geniculatus* (Latr.). This species was found commonly in the Chilibrillo caves by Clark and Dunn (1932) and earlier by Caudell (1924). The former authors found bugs naturally infected with *Trypanosoma cruzi* in these caves. Several visits to the caves in recent years have failed to show their presence. Specimens are occasionally taken in native houses, and a long series was taken on Barro Colorado Is., July, 1940, at light, with occasional specimens in March, April, November and December.

*Panstrongylus humeralis* (Usinger). This species was described from Barro Colorado Island, C. Z., and I have seen a series of 3 ♂ 1 ♀ from there, taken at light, Jan., 1941 by K. W. Cooper.

*Panstrongylus rufotuberculatus* (Champion). Described from Bugabá, Panama, this species seems to be rare. All material seen is from Barro Colorado Island, C. Z., at light, July, 1940 and Jan., 1941.

*Triatoma dimidiata* (Latr.). Rozeboom (1936) found specimens of this species naturally infected with *T. cruzi* in Chorrera, Panama. The species is fairly frequent in native houses, though no survey for them has been made. Specimens are on hand from Boquete, Chiriqui Prov., and from Barro Colorado Island, July, 1940, at light.

*Eutriatoma venosa* (Stal). This species does not appear to have been taken since Champion (1899) recorded specimens from the Volcan de Chiriqui.

*Rhodnius pallescens* Barber. This species, described from Panama in 1932, seems to be the most abundant house inhabiting Reduviid, as there are records from over a dozen localities in Panama and the Canal Zone in houses. It has also been taken on Barro Colorado Island, C. Z. at light, July, 1940 and November, 1941. Dunn (1933) found the species to be naturally infected with *T. cruzi*.

*Eratyrus cuspidatus* Stal. Apparently a rare species here, as I have seen only specimens reared in the laboratory from eggs laid by Dunn's original female, which was taken at Matias Hernandez, near Panama City. Dunn (1934) found this specimen to be naturally infected with *T. cruzi*. Mr. Zetek has also taken the species on Barro Colorado Island at light.

*Cavernicola pilosa* Barber. This curious little species was first collected from the Chilibrillo caves, where it probably feeds on bats. It is still abundant there, but efforts to maintain a colony in the laboratory have so far been unsuccessful.

*Cimex hemipterus* Fabricius. This, the tropical bedbug, seems to be the only species recorded here so far. It is common in native hotels, military barracks and hospitals, where constant reinfestation prevents its eradication. The open construction of houses in the tropics makes effective fumigation difficult.

#### *Siphonaptera*—fleas, "pugas"

Fleas are primarily important as vectors of plague, but they have also been incriminated in the transmission of endemic typhus and of tularaemia in ani-

mals. They also act as intermediate hosts of a number of helminth parasites of animals. One species, *Punga penetrans*, the chigger flea, burrows in the skin of man and animals.

The literature on flea control is very extensive, but the methods employed will not be discussed here. Any recent text-book of medical entomology may be consulted.

Nearly all our knowledge of the fleas found in Panama is due directly or indirectly to Dunn, whose papers are listed in the bibliography. Recently Fuller (1942) has published identifications of considerable material collected by Dunn in Panama with detailed host and locality records. The following list is compiled from these papers, with a few host and locality records added. In addition to the species listed, I have recently seen a manuscript by N. E. Good of the U. S. Public Health Service which gives two additional species as having been taken in Chiriqui Province.

*Pulex irritans* Linn. The human flea is not very common here, only occasionally becoming a serious pest. Dunn (1923) records an outbreak in a labor camp on the Atlantic side of the Isthmus, and recently a similar outbreak occurred in some barracks, also on the Atlantic side. Fuller (1942) records a specimen off dog, Panama City, and I have seen 2 lots from man, Moja Pollo, Chagres River region, May, 1941.

*Ctenocephalides felis* (Bouché). Fuller records specimens from wild rabbit (*Sylvilagus*), monkeys, dogs, raccoon and opossum (*Didelphis*), while specimens in the laboratory collection are from monkeys (*Cebus*), dogs, and man, all from localities in the Canal Zone or nearby Panama.

*Ctenocephalides canis* (Curtis). Dunn (1923) records this species once from a dog recently brought to the Isthmus from Swan Island, off the coast of Honduras. It is probably imported from time to time on dogs, but seems not to have become established.

*Xenopsylla cheopis* (Rothschild). According to Jennings (1910) and Dunn (1923) this is the only true rat flea in Panama, occurring on *Mus rattus*, *M. alexandrinus*, *M. norvegicus* and *M. musculus*. It was found to be most abundant on *alexandrinus*, the roof-rat, and rarest on the house-mouse. It is interesting to note that both Jennings and Dunn found the brown rat, *M. norvegicus*, to be the commonest species in both Colon and Panama, but that the species is not listed in Goldman's "Mammals of Panama" (1920).

*Rhopalopsyllus cacicus saevus* Jordan and Rothschild. Listed by Dunn (1934) from *Tamandua* and ocelot, and by Fuller from armadillo (*Dasypus*) (6 lots) and opossum (*Didelphis*) (4 lots).

*Rhopalopsyllus lugubris* Jordan and Rothschild. Fuller lists 2 lots from Ancon and the Chilibrillo caves off *Didelphis*. Dunn (1934) lists the species as *Rh. l. cryptoctenes* Enderlein off agouti, Camp Pital, Chiriqui. Fuller apparently missed the references to fleas in this paper.

*Rhopalopsyllus dunni* Jordan and Rothschild. Described from material collected by Dunn off cotton rats (*Sigmodon*) at Ft. Clayton, C. Z. Dunn (1923) records additional specimens off same host from Miraflores, C. Z.

*Rhopalopsyllus australis australis* (Rothschild). Recorded once by Fuller off *Didelphis* from Alajuela, Panama.

*Rhopalopsyllus australis tupinus* Jordan and Rothschild. Listed by Dunn (1934) off agouti (*Dasyprocta*) and by Fuller off peccary, Alajuela.

*Rhopalopsyllus australis tamoyus* Jordan and Rothschild. Fuller lists 2 lots off *Didelphis* from Ancon and the Chilibrillo caves.

*Rhopalopsyllus klagesi samuelis* Jordan and Rothschild. Dunn (1923) recorded the species as *klagesi* off spiny rat (*Proechimys*) at Pedro Miguel, C. Z. and off ocelot (*Felis pardalis*) La Cabima, Panama. Fuller adds specimens off opossum (*Didelphis*) from Alajuela.

*Ptilopsylla dunni* Kohls. This very recently described flea occurs on bats, the type material having been collected by L. H. Dunn off *Molossus coibensis* in Panama City. As yet only specimens from the original series are known.

*Echidnophaga gallinacea* (Westwood). Dunn (1923) records the stick tight flea of poultry as local in distribution, and gives dogs, cats, rats and man as additional occasional hosts. Fuller adds *Didelphis*.

*Tunga penetrans* (Linnaeus). The chigoe or sand flea, generally called "nigua" in Panama, seems to be common here only in certain localities. Dunn (1923) listed it from hogs, dog, cat and man, and stated that the first appeared to be the favorite host. He mentions seeing a severe infestation in a soldier from Chorrera, from whose feet 30 fleas were extracted. It was quite abundant on Chepillo Island, at the mouth of the Bayano River in 1942, where I saw both man and dog infested.

#### *Anoplura*—lice, "piojos"

No effort has been made to study the incidence of infestation of either human or animal lice in Panama beyond ascertaining the fact that head and body lice and crab lice occur. I am informed by doctors practicing here that all three species are present, but not very common, among their poorer patients. I have personally seen infestations of head lice only. As is well known, the body louse is the vector of epidemic typhus, of trench fever and of European relapsing fever, but none of these diseases is known to occur in Panama. In addition to these, a louse is known from spider monkeys (*Ateles*) and I have seen specimens of one of the cattle lice. It is probable that a search will reveal many more species upon both wild and domestic animals.

*Pediculus (Pediculus) humanus* Linn. Ewing (1926) has extensively discussed the various races of human lice, but no attempt is made here to determine to which form the Panama lice should be assigned.

*Pediculus (Parapediculus) atelophilus* Ewing. Frequent on the black spider monkey (*Ateles geoffroyi*) and necessitating periodic delousing of the monkeys in the laboratory colony. The absence of thumbs in this monkey may have something to do with the massive infestations occasionally seen.

*Phthirus pubis* (Linnaeus). The crab louse.

*Haematopinus eurysternus*. A massive infestation seen on cattle in Coclé Prov. in December, 1942, by Col. H. S. Eakins, who brought me the material

for identification. In Dunn's notes preserved at the laboratory, *H. asini* (Linn.) is recorded as having been taken from a horse at Summit, C. Z., but I have not seen the material.

#### *Ixodoidea*—ticks, "garrapatas"

The ticks are well represented in Panama, and have been fairly well studied by Dunn, whose papers are listed in the bibliography. Osorno (1941) has listed the species reported from Panama and Colombia in the literature, and has given keys to the genera and species. The present list includes 8 genera and 34 species.

As vectors of disease ticks are perhaps the most important of all arthropods. Huff (1938) list over twenty human and animal diseases known to be transmitted by ticks, and the list is constantly being increased. In Panama the tick *Ornithodoros rudis* Karsch is the known vector of human relapsing fever (Clark 1942), while Texas fever and probably also fowl spirochaetosis and canine piroplasmosis also occur, as their known tick vectors are common. Neither the spotted fever group of diseases nor tularaemia have been so far reported in Panama, though suitable tick vectors are present, and members of the first group of diseases are known from both north and south of the Isthmus.

Ticks are abundant and annoying in many parts of Panama, being especially numerous in jungle areas where there are plenty of the larger game animals, and in cattle raising sections, especially those where the cattle are not periodically dipped. Species of *Amblyomma* are the worst offenders, the larval ticks, known as "seed ticks," "cucucitas" or "garrapatitas" often occurring in incredible numbers during the dry season. The bites are very irritating and exceedingly liable to become secondarily infected. Protection consists in the wearing of tight clothing of a smooth texture and high boots. Long fuzzy cotton stockings have been recommended to trap the ticks. Ticks seen on the person should be removed promptly, or touched with a lighted cigarette. Some of the newer repellents developed against mosquitoes are also effective against ticks. The avoidance of native houses and beds and the use of a hammock which is examined daily will obviate exposure to the tick vectors of relapsing fever.

The nomenclature of the following list follows for the most part that of Nuttall, Warburton, Cooper and Robinson (1908-1926) where the species are treated by them, even though in a few cases the names used may not be correct. References to the original descriptions of all species not treated by them or described subsequently are included in the bibliography. Dr. R. A. Cooley has very kindly checked the determinations of the species of *Ornithodoros*, *Haemaphysalis kochi*, and some of the *Ixodes*. It was originally planned to treat the ticks of Panama in the same manner as was done in the case of the *Tabanidae* and *Simuliidae*, but this has not been possible at the present time.

*Ornithodoros talaje* Guérin-Méneville. Larvae on rats, dogs, cats, chicken, opossum and snake. Adults in houses, occasionally attacking man, but rodents probably principal host (Dunn 1933). Common throughout Panama.

*Ornithodoros rudis* Karsch (*venezuelensis* Brumpt). This species attacks rats

and domestic animals in the larval stage, while the adult attacks man freely. It is probably the principal vector of relapsing fever to man. Common in native houses throughout Panama.

*Ornithodoros brodyi* Matheson. Hosts probably bats. Common in the Chilibre bat caves.

*Ornithodoros dunni* Matheson. Reared from larvae on bats from Panama City and Summit, C. Z.

*Ornithodoros azteci* Matheson. Reared from larvae on bats, Summit, C. Z., and Taboga Island. Adults from Chilibre caves and other caves and culverts used as bat roosts in Panama and the Canal Zone.

*Argas persicus* Oken. The common fowl tick. Abundant throughout the Republic in chicken coops, hen houses, etc. It is the vector of fowl spirochaetosis. The larvae sometimes attack man.

*Ixodes minor* Neumann. 1 ♀, off *Peromyscus nudipes* or *Oryzomys devius*, Finca Lerida, Boquete, Chiriqui Prov., Aug., 1941, 8000 ft. R. K. Enders coll. Host det. Enders.

*Ixodes loricatus* var. *spinus* Nuttall. 4 ♂ off *Didelphis marsupialis etensis*, Alajuela, Chagres River valley. Dunn coll.

*Ixodes bicornis* Neumann. Many ♂, ♀ and nymphs off dog, Finca Lerida, Boquete, Chiriqui Prov. (Mrs. T. B. Monniche coll.) det. R. A. Cooley 1942.

*Ixodes affinis* Neumann. ♂, ♀ off *Mazama sartorii reperticia*, El Real, Darien, Aug. 19, 1930 Dunn coll.; off *Odocoileus chiriquensis*, Alajuela, C. Z. Dunn coll., all det. Cooley 1942. This seems to be the species recorded by Dunn (1923) as *Ixodes ricinus*. Nuttall et al. (1911) record the species as *I. ricinus* var. *scopularis* Say.

*Rhipicephalus sanguineus* (Latreille). Common throughout Panama on dogs, but very rare on any other animals. This tick is the vector of canine piroplasmiasis, of *Leucocytozoon canis* and of *Rickettsia brasiliense* in the western hemisphere.

*Dermacentor nitens* Neumann. The common tropical horse tick. Attacks horses and mules by preference, but often found on cattle, and there are two records from deer in Panama. Very common throughout the Republic. Darling (1913) and Dunn (1923) have suggested this tick as the probable vector of equine piroplasmiasis in Panama.

*Dermacentor latus* Cooley 1937. A single male of this tick, described from Costa Rica off tapir, was taken off a dog, Finca Lerida, Boquete, Chiriqui Prov. (Mrs. T. B. Monniche).

*Amblyomma americanum* (Linnaeus). Recorded by Dunn (1923) as being taken once on the Pearl Islands. I have seen no specimens from the Panama mainland.

*Amblyomma auricularium* (Conil.) (*concolor* Neum.). Armadillos of various species seem the preferred hosts in Panama, as we have 23 lots collected from them, and only 9 from other animals, including cat, *Didelphis*, *Tamandua*, *Philander*, hog and coati (*Nasua*). Dr. R. A. Cooley in a letter to me has listed *Amb. inornatum* (Banks), no host, Balboa, C. Z. The species

of this group also include *curruca* Schulze and *pseudoconcolor* Aragão, and are in need of further study.

*Amblyomma cajennense* (Fabricius). This is one of the most abundant species of the genus throughout Panama, its hosts including a wide range of mammals and even birds. The larvae of the various species of *Amblyomma* are very difficult to distinguish, and it is probable that a number of species will attack man in this stage. *A. cajennense* seems to be the only one of the genus which will attach to man at all commonly in the adult stage, although several other species have been taken crawling on the person of the author. In Panama horses and cattle are the commonest recorded hosts. It is an important vector of Rocky Mountain spotted fever in Brazil.

*Amblyomma calcaratum* Neumann. Three lots of what appear to be this tick have been taken in the Canal Zone or nearby Panama. All were from *Tamandua tetradactyla*. Specimens from sloths appear to be slightly different, being considerably larger, less ornate and with the punctations more unevenly distributed.

*Amblyomma coelebs* Neumann. Recorded by Dunn (1934a) from tapir. I have also seen 1 ♂ off Tapir from the Bayano River, Darien and 1 ♀ off horse, Cerro Azul, Panama Prov., R. P. It seems to be a rare species here.

*Amblyomma crassum* Robinson.

*Amblyomma sabanerae* Stoll.

*Amblyomma humerale* Koch. *Crassum* was described from Darien, *sabanerae* from Guatemala, both from females only, while *humerale* was described from both sexes from Bahia, Brazil. 3 ♀ from Panama show resemblances to both *crassum* and *sabanerae*, the 6 ♂ available lack all markings except shoulder spots. Extensive material may well show only a single species. Dunn records the species as *humerale* from tortoise, Boqueron River region (1923), and off tapir, Aguas Buenas (1934a). More recent material is all from tortoises, in one case determined as *Geomydas annulata*, from Juan Mina (3 ♂ 1 ♀) and Moja Pollo (1 ♂ 1 ♀) in the Chagres River valley, and from Barro Colorado Is. (2 ♂, 1 ♀).

*Amblyomma dissimile* Koch. The common reptile tick in Panama. Recorded off at least 6 species of snakes, iguana, and the common toad, *Bufo marinus*. Infestations of this tick in the laboratory snake pens have caused the death of several specimens of fer-de-lance and bushmaster, in one case 190 ticks being taken from a single small fer-de-lance. Dunn (1918, 1923) has studied the life history and prevalence of this tick.

*Amblyomma geayi* Neumann. Although this species was described from Darien, and appears to be the commonest tick on sloths in Panama, it was somehow missed by Dunn. There are 15 lots from *Bradypus*, 2 from *Choloepus* and 3 labelled simply "sloth" from various localities in Panama and the Canal Zone. The species would seem to show a preference for the three-toed sloth here.

*Amblyomma gertschi* Cooley 1942. This species has recently been described from a single male off three-toed sloth, Barro Colorado Is., C. Z. It is close



to *calcaratum*, but is larger, and has but a short spur on the 4th coxa. A few specimens taken in company with this species differ only in having a long spur, like *calcaratum*, but are otherwise just like *gertschi*. Specimens of *gertschi* are in the laboratory collection labelled *varium*, so this is probably the species recorded under that name by Dunn. 15 lots of about 40 specimens, all males but one and all from sloths, about evenly divided between *Bradypus* and *Choloepus*, are in the collection.

*Amblyomma longirostre* (Koch). Porcupines of various species are the only regular hosts of the adults. Recorded by Dunn (1923) and since taken once, off procupine, Gatun, C. Z., Jan. 2, 1932. 3 ♂.

*Amblyomma naponense* Packard. According to Osorno (1941), this is the correct name for the species recorded by Dunn (1934b) off collared peccary as *mantiquirense* Aragão. Dunn previously reported (1923) as *naponense* specimens off *Tamandua tetradactyla* and collared peccary. I have seen a pair, no host, no locality, but probably part of Dunn's material.

*Amblyomma nodosum* Neumann-Dunn (1923) records the species as common on the three-toed anteater, *Tamandua tetradactyla*, but I have seen but 2 lots, one unlabelled, presumably from Dunn's material, and the other, 1 ♂, 1 ♀ off *Tamandua tetradactyla*, Tumba Muerta, Panama, Sept. 13, 1932, Dunn coll.

*Amblyomma oblongoguttatum* (Koch). This appears to be the most abundant tick in Panama, attacking a wide variety of hosts. Cattle, horses, dog, deer and coati (*Nasua*) are recorded as hosts five or more times in the material at hand, while hog, goat, tapir, man, fowl, agouti (*Dasyprocta*) brocket (*Mazama*), ant-eater (*tamandua*) and peccary are recorded from one to four times. Under the name *darlingi*, Dunn (1923) records the species from the black vulture (*Catharista*) and wild turkey (*Craze panamensis*). It attacks man more rarely, at least as adults, than does *cajennense*, only two lots having been taken from man.

*Amblyomma ovale* (Koch). The dog seems to be the favored host for this tick although records are at hand for man and tapir also. Dunn records specimens from *Tamandua* (1923), tapir (1934a) and squirrel monkey (1934b), though probably only dog and tapir are true hosts. The species is moderately abundant, 13 lots having been studied.

*Amblyomma paca* Aragão. 2 lots, one a single female without data, the other of 2 ♂, 2 ♀ from *Cuniculus paca*, Panama, R. P., Oct. 27, 1933. The determination is tentative, as the specimens are not too well preserved and differ in certain minor respects from the description and figures in Nuttall et al. (1926).

*Amblyomma parvum* Aragão. Dunn (1923) records the taking of adults from deer (*Odocoileus*) on Ancon Hill, C. Z., and nymphs and larvae from cotton rats (*Sigmodon hispidus*). Recently 1 ♂, 1 ♀ were collected by Col. H. S. Eakins in Coeló Prov., off cattle.

*Amblyomma pecarium* Dunn 1933. 3 ♂ paratypes, lacking capitula, of this interesting little species are preserved in the laboratory collection. De-

scribed from peccary, (*Pecari angulatus bangsi*) the paratypes were taken at Miraflores, C. Z., April 11, 1932 by R. Isaacs. No specimens have been taken since.

*Amblyomma tapirellum* Dunn 1933. This tick superficially resembles *A. cajennense*, but is quite distinct. 7 lots are at hand from tapir, man, horse, and peccary, and it seems fairly abundant in some localities. A lot of 17 ♂ and ♀ were taken on Barro Colorado Is., by sweeping vegetation along the trails with a flag of flannel on March 5, 1943. *A. oblongoguttatum* was also taken, but no *A. cajennense*.

*Haemaphysalis kochi* Aragão. Dunn(1923) has reported this species from deer and tapir, and 3 additional lots from deer have been collected since. A single male was taken by dragging a piece of flannel along a trail through the bush near Corozal, C. Z., March 3, 1943.

*Haemaphysalis leporis-palustris* Packard. No specimens have been taken since those recorded by Dunn (1923) off domestic rabbit and *Dasyprocta*. This tick has been reported as harboring *Bacterium tulareense*, the agent of tularaemia, in Alaska (Philip and Parker 1938), and probably serves to spread the disease from rabbit to rabbit. It is also a vector of Rocky Mountain spotted fever in western U. S.

*Boophilus microplus* (Canestrini). The common cattle tick in Panama, where it is by far the most abundant tick on these animals. It has also been taken from horse, dog, goat and deer in Panama. It is apparently the vector of bovine piroplasmiasis or Texas fever here. Dunn (1923) records *B. annulatus* (Say) from newly imported cattle, but it seems not to have become established. *Boophilus cyclops* Minning is also recorded from Panama, but the validity of this species is doubtful.

*Spelaeorhynchus latus* Banks. The identification of a single specimen of this curious mite-like tick rests on the diagnosis given by Ewing (1929, p. 69) as I have not been able to consult the original description. Da Fonseca (1935) has reviewed the references to the genus and added information on hosts and distribution. Banks' material came from Obispo, C. Z., and I have seen a single specimen off *Artibeus jamaicensis* Summit, C. Z., Jan. 9, 1941, K. W. Cooper col. The specimen is labelled as coming from the ear.

#### *Acarina*—mites and red-bugs, chiggers, harvest mites or "coloradillas"

No systematic attempt to collect this group of arthropods has been made. There are doubtless a great many species parasitic on various animals here, but the literature is scattered and for the most part unavailable. The following list therefore contains only references to definite records of species of *Trombidiidae*. Scabies, caused by infestation with *Sarcoptes scabiei* de Geer, is not uncommon in Panama, but I can find no references to its occurrence or distribution in the literature. Dr. Lawrence Getz tells me that infestations of *Demodex folliculorum* serious enough to require treatment are occasionally seen here. The red-bugs, harvest mites or chiggers are the larvae of various species of *Trombicula* and related genera. They are world-wide in distribution and attack nearly all

classes of animals. The adults live a non-parasitic life on the ground among trash, humus and dead vegetation, only the six-legged larvae being parasitic. Radford (1942) has listed the known larval species for the world, giving 14 genera and 156 species. Of these, 16 species of 5 genera are reported as taken from man. A number of other species are known only from adults. Boshell and Kerr (1942) have recently described 25 additional species, mostly adults, from Colombia, of which one is said to attack man.

Species of this group are the vectors of tsutsugamushi disease or Japanese river fever, and are believed to be vectors of similar typhus-like fevers in the East Indies. They have not been incriminated as vectors of human disease in the New World. The bites are quite irritating, and in susceptible persons exposed to heavy infestation may lead to nervous symptoms (Ewing 1921). Sulfur, either as powder dusted into the socks (Ewing 1921) or combined with soap and applied as a lather (Romeo 1942) is the classic repellent, but some of the recently developed organic mosquito repellents promise to be equally effective. Sutton (1942) recommends ethyl amino benzoate in flexible collodion as a local application to relieve the often intense itching of the bites.

The tropical rat mite, *Lyponyssus bacoti* Hirst, shown by Dove and Shelmire (1931) to be a vector of endemic typhus, very likely occurs here, though I have seen no specimens.

*Trombicula aleei* Ewing 1926. Described from the adult only, no host. Barro Colorado Is., C. Z.

*Trombicula cavernarum* Ewing 1933. A species described from adult specimens taken in cracks in the walls of the Chilibrillo bat caves.

*Trombicula dasypoctae* Ewing 1937. Described from larvae off agouti (*Dasyprocta*) from Capira, Panama.

*Trombicula trifurca* Ewing 1933. Described from adults from the Chilibrillo caves, the host probably being some species of bat.

*Eutrombicula dunni* Ewing 1931. Described from larvae off agouti from Chiriqui, Panama. Dunn (1934) gives additional information about this material, adding *Nasua narica panamensis*, the coati, as an additional host.

*Eutrombicula göldii* (Oudemans). Adult specimens taken in a Berlese filter on Barro Colorado Is. by Mr. James Zetek were determined as this species by Dr. Ewing. It is recorded as one of the commonest species in Columbia by Boshell and Kerr.

*Eutrombicula hominis* Ewing 1933. Described from larvae off man, Aguas Buenas, Panama. This is the only species recorded as attacking man in Panama.

*Eutrombicula panamensis* Ewing 1925. Described from larvae off cotton rat (*Sigmodon hispidus chiriquensis*), Balboa, C. Z.

#### REFERENCES

- AUBERTIN, A., AND BUXTON, P. A. 1934. *Cochliomyia* and *Myiasis* in Tropical America. *Ann. Trop. Med. Parasit.*, 28, 3, pp. 245-254, 1 Pl.
- BEQUAERT, J. 1924. Report of an entomological trip to the Truxillo division, Honduras, to investigate the sandfly problem. 13th Ann. Rep. Med. Dept. United Fruit Co., pp. 193-206.

- BLACKLOCK, D. B. 1926. The development of *Onchocerca volvulus* in *Simulium damnosum*. Ann. Trop. Med. Parasit., 20, pp. 1-48; 203-216.
- BOSHELL, J., AND KERR, J. A. 1942. Veinticinco especies nuevas de Trombidiideos en Colombia. Rev. Acad. Colombiana Cienc. Exactas, Fisica-Quimicos y Naturales, 5, 17, pp. 110-127, 7 Plates.
- BUCKLEY, J. J. C. 1934. On the development in *Culicoides furens* Poey of *Filaria ozzardi* Manson 1897. J. Helminthology, 12, (2), pp. 99-118.
- CAUDELL, A. N. 1924. Some insects from the Chilibrillo bat caves of Panama. Ins. Ins. Mens., 12, pp. 133-136.
- CONNAL, A., AND CONNAL, S. L. M. 1922. The development of *Loa loa* (Guyot) in *Chrysops dimidiata* van der Wulp. Trans. Roy. Soc. Trop. Med. Hygiene, 16, pp. 64-89.
- COOLEY, R. A. 1937. Two new Dermacentors from Central America. J. Parasit., 23, pp. 259-264, Pl. 1, figs. 1-2.
- COOLEY, R. A. 1942. *Antricola* new genus, *Amblyomma gertschi* new species, and notes on *Ixodes spinipalpis* (Acarina: Ixodoidea). Publ. Health Repts., 57, 46, p. 1736, 1 Pl., 1 fig.
- COQUILLET, D. W. 1907. Discovery of blood-sucking *Psychodidae* in America. Entomological News, 18, pp. 101-102.
- CLARK, H. C. 1942. Relapsing fever in Panama. Publ. No. 18, Amer. Assn. Adv. Sci., pp. 29-34.
- CLARK, H. C., AND DUNN, L. H. 1932. Experimental studies on Chagas' disease in Panama. Amer. J. Trop. Med., 12, 1, pp. 49-77.
- CUSHING, E. C., AND HALL, D. G. 1937. Some morphological differences between the screw worm fly, *Cochliomyia americana* C. and P., and other closely allied or similar species in North America. Proc. Ent. Soc. Washington, 39, 7, pp. 195-198, 2 Plates.
- DARLING, S. T. 1911. Oriental sore in Panama. Proc. Canal Zone Med. Assn., 3, Pt. 2 (1910), pp. 7-20, 2 figs.
- DARLING, S. T. 1913. Equine piroplasmiasis in Panama. Proc. C. Z. Med. Assn., 6, Pt. 1, pp. 55-59.
- DUNN, L. H. 1916. Observations on the preoviposition, oviposition and incubation periods of *Dermacentor nitens* in Panama. Proc. Med. Assn. Isthmian Canal Zone, 7, Pt. 2, pp. 51-56.
- DUNN, L. H. 1918. Studies on the Iguana tick, *Amblyomma dissimile* in Panama. J. Parasit., 5, 1, pp. 1-10.
- DUNN, L. H. 1918a. Studies on the screw-worm fly, "*Chrysomya macellaria*" in Panama. J. Parasit., 4, pp. 111-121. Also in Proc. Med. Assn. Isthm. C. Z., 10, Pt. 2 (1917), pp. 33-66. 1919.
- DUNN, L. H. 1923. The ticks of Panama, their hosts and the diseases they transmit. Amer. J. Trop. Med., 3, 2, pp. 91-104.
- DUNN, L. H. 1923a. The fleas of Panama, their hosts and their importance. Amer. J. Trop. Med., 3, 4, pp. 335-345.
- DUNN, L. H. 1923b. The tropical bedbug in relation to the transmission of relapsing fever in Panama. Amer. J. Trop. Med., 3, pp. 345-350.
- DUNN, L. H. 1927. Notes on two species of South American ticks, *Ornithodoros talaje* Guerin-Meneville, and *O. venezuelensis* Brumpt. J. Parasit., 13, 3, pp. 177-182.
- DUNN, L. H. 1930. Rearing the larvae of *Dermatobia hominis* Linn., in man. Psyche, 37, 4, pp. 327-342, 1 text fig., 1 Pl.
- DUNN, L. H. 1931. Notes on the tick *Ornithodoros talaje* infesting a house in the Canal Zone. Psyche, 38, 4, pp. 170-173.
- DUNN, L. H. 1933. Observations on the host selection of *Ornithodoros talaje* Guerin in Panama. Amer. J. Trop. Med., 13, 5, pp. 475-483.
- DUNN, L. H. 1933a. Two new species of ticks from Panama. (*Amblyomma tapirellum* and *A. pearingium*). Parasitology, 25, 3, pp. 353-358, 4 figs.
- DUNN, L. H. 1934. Attempts to transmit *Trypanosoma cruzi* Chagas with ticks of the genus *Ornithodoros*. Amer. J. Trop. Med., 14, 3, pp. 283-289.

- DUNN, L. H. 1934a. Ticks from tapirs of Panama. *J. Parasit.*, **20**, 5, p. 312.
- DUNN, L. H. 1934b. Entomological investigations in the Chiriqui region of Panama. *Psyche*, **41**, 3, pp. 166-183.
- DUNN, L. H. 1934c. Notes on the Reduviid bug, *Eratyrus cuspidatus* Stål, naturally infected with *Trypanosoma cruzi* Chagas found in Panama. *Amer. J. Trop. Med.*, **14**, 3, pp. 291-292.
- DUNN, L. H., AND CLARK, H. C. 1933. Notes on relapsing fever in Panama with special reference to its animal hosts. *Amer. J. Trop. Med.*, **13**, 2, pp. 201-209.
- DYAR, H. G. 1925. The mosquitoes of Panama. *Ins. Ins. Mens.*, **13**, 7-9, pp. 101-195.
- DYAR, H. G. 1929. The present knowledge of the American species of *Phlebotomus* Rondani. (Diptera: Psychodidae). *Amer. J. Hygiene*, **10**, 1, pp. 112-124, 4 figs.
- EWING, H. E. 1921. Studies on the biology and control of chiggers. U. S. Dept. Agric., Bull. 986, pp. 1-19, 4 figs.
- EWING, H. E. 1926. A review of the American lice of the genus *Pediculus*, together with a consideration of the significance of their geographical and host distribution. *Proc. U. S. Nat. Museum*, **68**, Art. 19, pp. 1-30, Pls. 1-3.
- EWING, H. E. 1926a. Key to known adult *Trombiculas* (adults of chiggers) of the new world, with descriptions of two new species. (Acarina: Trombicoidae) *Entomological News*, **37**, pp. 111-113.
- EWING, H. E. 1929. A manual of external parasites. C. T. Thomas, Baltimore.
- EWING, H. E. 1931. A catalogue of the *Trombiculinae* or chigger mites of the new world, with new genera and species and a key to the genera. *Proc. U. S. Nat. Mus.*, **80**, 8, pp. 1-19.
- EWING, H. E. 1933. Three new chigger mites of the genus *Trombicula* from Panama, with a key to the known adults of *Trombicula* of the new world. *Proc. U. S. Nat. Mus.*, **82**, 29, pp. 1-6.
- EWING, H. E. 1937. New species of mites of the subfamily *Trombiculinae* with a key to the new world larvae of the *Akamushi* group of the genus *Trombicula*. *Proc. Biol. Soc. Washington*, **50**, 44, pp. 167-173.
- FAIRCHILD, G. B. 1940. Notes on the *Simuliidae* of Panama (Diptera: Nematocera). *Ann. Ent. Soc. Amer.*, **33**, 4, pp. 701-719, 3 Pls.
- FAIRCHILD, G. B. 1942. Notes on *Tabanidae* (Dipt.) from Panama. X. The genus *Tabanus* and resume of the *Tabanidae* of Panama. *Ann. Ent. Soc. Amer.*, **35**, 4, pp. 441-474, 2 Pls.
- DA FONSECA, F. 1935. Notas de Acareologia. XVII. Localização, frequência, distribuição geográfica e hospedeiros de *Spelaeorhynchus latus* Banks, 1917 (Acarina: *Spelaeorhynchidae*). *Mem. Inst. Butantan*, **9**, pp. 145-148.
- FRANCIS, E., AND MAYNE, B. 1922. Experimental transmission of Tularaemia by flies of the species *Chrysops discalis*. U. S. Publ. Health Serv., Hygienic Lab. Bull. 130, pp. 8-16.
- FULLER, H. S. 1942. Notes on neotropical *Siphonaptera*. *Rev. Ent.*, Rio, **13**, 1-2, pp. 39-44.
- GOLDMAN, E. A. 1920. Mammals of Panama. *Smithsonian Misc. Coll.*, **69**, 5, p. 229.
- HUFF, C. G. 1938. In: Hegner, Root, Augustine and Huff, *Parasitology*, with special reference to man and domesticated animals. D. Appleton-Century Co., New York.
- HOFFMAN, W. A. 1925. A review of the species of *Culicoides* of north and central America and the West Indies. *Amer. J. Hygiene*, **5**, 3, pp. 274-301, 2 Pls.
- JENNINGS, A. H. Rats and fleas in their relation to bubonic plague (with special reference to Panama and the Canal Zone). *Proc. Canal Zone Med. Assn.*, April-Sept., 1910, pp. 119-133.
- JOHNSON, C. M. 1941. Bovine Trypanosomiasis in Panama. *Amer. J. Trop. Med.*, **21**, 3, pp. 289-297.
- JOHNSON, C. M., AND KELSER, R. A. 1937. The incidence of Chagas' disease in Panama as determined by the complement-fixation test. *Amer. J. Trop. Med.*, **17**, 3, pp. 385-392.

- JOHNSON, C. M., AND DE RIVAS, C. T. 1936. La Enfermedad de Chagas en Panama. Novena Reunion Soc. Arg. Pat. Reg., Mendoza (1935), pp. 245-251.
- JOHNSON, C. M., AND DE RIVAS, C. T. 1936. Six new cases of Chagas' disease in Panama with review of previous cases. Amer. J. Trop. Med., **16**, 1, pp. 47-57.
- KAPUR, H. R. 1941. Experiments on the transmission of rinderpest through the agency of *Tabanus orientis*, with remarks on the feeding habits of this fly. Indian J. Vet. Sci., **11**, pp. 84-93.
- KNAB, F. 1914. A new *Cuterebra* from Panama. Ins. Ins. Mens., **2**, 12, pp. 187-188.
- KOHL, G. M. 1942. *Siphonaptera: Ptilopsylla dunnii*, a new species of bat flea from Panama. J. Parasit., **28**, 5, pp. 361-362, 1 fig.
- LORENZANA, L. R. 1940. La Onchocercosis. Anales Escuela Nac. Cienc. Biol., Mexico, **2**, 2-5, pp. 285-330, 1 map, 2 figs.
- LOTZE, J. C., AND YIENGST, M. J. 1941. Mechanical transmission of Bovine Anaplasmosis by the horsefly, *Tabanus sulcifrons*. Amer. J. Vet. Res., **2**, 4, pp. 323-324, 1 fig.
- LUTZ, A., AND NEIVA, A. 1912. Notas Dipterológicas. A proposito da *Mydaea pici* Macq. Mem. Inst. Oswaldo Cruz, **4**, 1, pp. 130-135.
- MATHESON, R. 1935. Three new species of ticks. *Ornithodoros* (Acarina: Ixodoidea). J. Parasit., **21**, 5, pp. 347-353, 7 figs., 1 Pl.
- MAZZA, S., AND JÖRG, M. E. 1939. *Cochliomyia hominivorax* (Coq.) americana C. y P., estudio de sus larvas y consideraciones sobre miasis. Mision de estudios de Patologia Regional Argentina, Jujuy. Publ. No. 41, pp. 3-46, 38 figs., 1 col. Pl.
- MCCOY, O. R. 1933. The occurrence of *Microfilaria ozzardi* in Panama. Amer. J. Trop. Med., **13**, pp. 297-310.
- MITZMAIN, M. B. 1913. The mechanical transmission of Surra by *Tabanus striatus* Fab. Philippine J. Sci., **8**, pp. 223-229.
- NEIVA, A., AND LENT, H. 1941. Sinopsis dos Triatomídeos. Revista de Entomologia, Rio, **12**, 1-2, pp. 61-92, 27 figs.
- NUTTALL, WARBURTON, COOPER AND ROBINSON. 1908-1926. Ticks, a monograph of the Ixodoidea. Pts. I-IV. Cambridge University Press.
- OSORNO MESA, E. 1941. Las Garrapatas de la República de Colombia. Ann. de la Acad. Nac. Med., Bogota, for the years 1938-1940, pp. 398-434, 2 figs. and map.
- PAINTER, R. H. 1926. The biology, immature stages and control of the sandflies (biting *Ceratopogonidae*) at Puerto Castilla, Honduras. 15th Ann. Rep. Med. Dept. United Fruit Co., pp. 245-262, 9 figs.
- PHILIP, C. B., AND PARKER, R. R. 1938. Occurrence of Tularemia in the rabbit tick (*Haemaphysalis leporis-palustris*) in Alaska. Publ. Health Repts., **53**, 15, pp. 574-575.
- RADFORD, C. D. 1942. The larval *Trombiculinae* (Acarina: Trombididae) with descriptions of twelve new species. Parasitology, **34**, 1, pp. 55-81, 106 figs.
- ROMEO, Z. J. 1942. Sulfur and soap as effective prophylaxis against chiggers (red bugs) in the Army. Military Surgeon, **90**, 4, pp. 437-439.
- ROOT, F. M. 1934. Some American species of *Phlebotomus* with short terminal palpal segments. Amer. J. Hygiene, **20**, pp. 233-246, 5 figs.
- ROZEBOOM, L. E. 1936. *Triatoma dimidiata* Latr., found naturally infested with *Trypanosoma cruzi* Chagas in Panama. Amer. J. Trop. Med., **16**, 4, pp. 481-484.
- ROZEBOOM, L. E. 1940. *Flebotomus suis*, a new *Flebotomus* from Panama (Diptera: Psychodidae). Amer. J. Hygiene, Sec. C, pp. 8-11, Pl. 1.
- SHANNON, R. C. 1926. The occurrence of *Phlebotomus* in Panama. J. Washington Acad. Sci., **16**, pp. 190-193.
- SHANNON, R. C., AND GREENE, C. T. 1926. A bot-fly parasitic in monkeys. Zoopathologica, **1**, 7, pp. 285-290.
- SHARP, N. A. D. 1928. *Filaria perstans*: its development in *Culicoides austeni*. Trans. Roy. Soc. Trop. Med. Hygiene, **21**, pp. 371-396.
- SMART, J. 1940. *Simuliidae* (Dipt.) from British Guiana and the Lesser Antilles. Trans. Roy. Ent. Soc. London, **90**, 1, pp. 1-11, 4 Pls., 3 figs.

- STEWART, J. S. 1932-33. *Onchocerca cervicalis* and its development in *Culicoides nubeculosus*. Univ. Cambridge Inst. Animal Path., Third Rept., pp. 272-284, 24 figs.
- STEIN, C. D., LOTZE, J. C., AND MOTT, L. O. 1942. Transmission of equine infectious anaemia by the stable fly, *Stomoxys calcitrans*, the horse fly, *Tabanus sulcifrons*, and by injection of minute amounts of virus. Amer. J. Vet. Res., **3**, 7, pp. 183-193 and figs.
- STRONG, R. P., SHATTUCK, G. C., BEQUAERT, J. C., AND WHEELER, R. E. 1926. Med. Rept. Hamilton Rice seventh exp. to the Amazon, etc. Contrib. No. IV, Harvard Inst. Trop. Biol. Med. Harvard University Press.
- STRONG, R. P., SANDGROUND, J. H., BEQUAERT, J. C., AND OCHOA, M. M. 1934. Onchocerciasis, with special reference to the Central American form of the disease. Contrib. No. VI, Harvard Inst. Trop. Biol. Med. Harvard University Press.
- SUTTON, R. L. JR. 1942. Trombidiosis (chigger bites). Relief of itching with ethyl amino benzoate in flexible collodion. J. Amer. Med. Assn., **120**, 1, p. 26.
- VARGAS, L. 1942. (Article in) Medicina, Revista Mexicana, **22**, 420, pp. 458-459.
- VAN DER WULP, F. M. 1888. Biologia Centrali Americana, Dipt., **2**, p. 2.