

MAN'S UNINVITED FELLOW TRAVELER—THE COCKROACH*

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THE cockroaches are insects which to the average person are house-haunting pests, living secretive lives away from the light of day, and creeping into one's larder when given the slightest opportunity. Most definitely they produce in the majority of people a strong feeling of aversion. It often takes some effort to convince the "doubting Thomases" that the number of species of cockroaches which are domiciliary pests is greatly limited—in fact less than one percent of the known forms—and that cockroaches of many kinds are diurnal, with hundreds of species tropical forest foliage forms, others semiaquatic, some in one sex living in the ground, a few wood-boring, while a dozen or so genera will be found, in a state of either known or suspected commensalism, in the nests of ants, wasps or termites.

From all these far more interesting biological associations, however, we are almost always brought back to those domiciliary cockroaches which to most people give the group a reason for its existence, and it is on these that the oft-repeated questions are centered. An inevitable one is, "Where did this species come from originally?" Rather helplessly most entomologists then pick up a few standard and rather well-thumbed textbooks, and read this or that wording of stereotyped traditional explanations that this species "came from the Orient," and the other "is a native of tropical America." Unfortunately hardly any standard work of reference has given correctly the most probable original homes of some half-dozen of our better-known domiciliary, or habitation litter inhabiting, species, and almost every new treatment of these species simply repeats the erroneous assumptions of the past. The chief justification for this course

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will be found in the unfortunate technical specific names applied to them long ago by systematic pioneers, appellations such as *orientalis*, *germanica*, *americana*, *australasiae*, *surinamensis* and *maderae*. According to their light of many decades past these early scholars applied specific names suggested by the territory from which they received their specimens, or that from which it was believed they had come. The difficulty was that in the former case the species often had gone there as a fellow traveler with the early voyagers, and thus became one of the "first settlers."

During the past thirty-five years, individually or with my colleague Mr. Morgan Hebard, I have made a number of critical studies on the systematics and distribution of the cockroaches of both the New and Old Worlds. Mr. Hebard personally has added to these many equally important contributions, and a large amount of as yet unpublished critical information has also been assembled from the unsurpassed collections of the family which have been assembled at the Academy of Natural Sciences of Philadelphia. In addition the series of these insects in virtually all other important American institutions have been drawn upon, and we also have been able to study extensive representations from the collections of great European institutions such as the British Museum (Natural History), the French National Museum of Natural History, the Museum of the Belgian Congo, and a number of other museums scattered over the world.

In the cockroaches, or Blattidae, as in most other groups of the Orthoptera, we find a very marked degree of geographic limitation of genera, very few except those spread by commerce being world-wide in distribution. However, in analyzing problems of blattid distribution or centers of origin, it

is necessary to realize that we are dealing with a group which in considerable part possesses a broad range of coverage in adaptability, and also in ease of transport. We are also concerned with a very ancient group, with long-tested and often quite flexible survival powers, as the blattids would not have covered their great span of geological time if this were not so. The group has, and doubtless has had, many forms so highly specialized that they are virtually incapable of utilizing various means of transport, or of surviving in reasonably different environments if they should be so placed. On the other hand, we have a more limited number of adaptable types, which readily can be transported, and, given their required temperature and humidity tolerance, are thoroughly capable of establishing themselves fully and enduringly on the other side of the world, or at any suitable intermediate station.

Until the last forty years, our knowledge of the taxonomic relationship of many of the blattids was very unsatisfactory, particularly the concepts of generic units. While the classification of the superfamily Blattoidea remains in a somewhat unsettled condition, without general agreement as to the limits of the higher groups, in the main it is definitely on a sounder basis than it was in 1900, and our understanding of the character, limits, and relationship of many of the genera now rests upon a far greater knowledge than was possessed at that time. In consequence, it is possible by drawing upon information now available on the distribution of near relatives of species which have acquired a domiciliary status to secure important evidence as to the original homes of the latter.

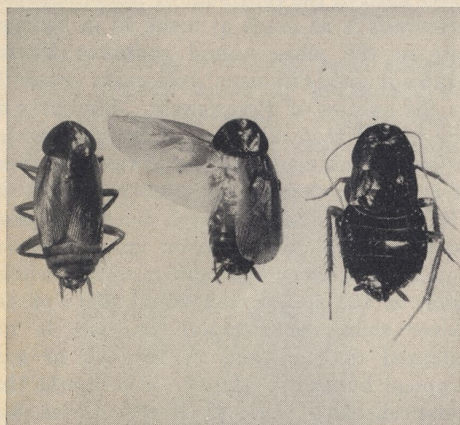
We must bear in mind that domiciliary habits are acquired ones, like domesticity in the dog, cat, horse, ox, sheep, or goat. Probably some cockroaches, in a feral state, fed upon and lived in material which early men pre-empted as a food, and their passage into his habitations, in that way, was at first a physical transfer. With an assured abundance of food, particularly of varied character such as would appeal to insects which are largely omnivorous, it is not difficult to

appreciate the beginning of the domiciliary habit.

Dependence of cockroaches upon human habitations, however, varies in degree, and some species, such as *Pycnoscelus surinamensis*, though occurring commonly in the litter and topsoil about buildings, are not as a rule found within buildings except greenhouses and similar structures. Again, many species are accidentally transported from tropical regions in fruit and similar products to much colder regions, and are there unable to survive, or at least propagate, in houses or similar structures, even when the proper food is provided, unless the required temperature is maintained. One species will require only a temperature above a specific minimum; for another, a certain range of relative humidity is as important as temperature.

TAXONOMIC and distributional studies of recent cockroaches, or the family Blattidae, with which I have been engaged for a number of years, have brought together a very considerable amount of information on the thousands of existing species of this ancient group. One of these is the cockroach probably best known to American entomologists and perhaps laymen as well: *Blatta orientalis*, the so-called Oriental Cockroach, Shad Roach, or Black Beetle (Fig. 1). With us it is one of our commonest household pests, at home in almost any situation which promises food and warmth. In the literature of the past we find the very general assumption that *Blatta orientalis*, the "Oriental Cockroach," came from what is rather vaguely defined as "the East." Linnaeus, the great father of systematics, in 1758 considered the species as native to America and as introduced in the East. He noted it as common in Russia and as having reached Stockholm in 1739. The exact reason for his indication of America as its original home is not at all clear, but certainly he was wrong. No members of the genus to which *orientalis* belongs or of any very closely related genera are American endemics. Carl Brunner, the great Austrian orthopterist, in 1865 felt that *orientalis* originated in Asia, and he then stated it "abounds in the East Indies as

well as in Asia Minor," but he added "it is rare on the coasts of the Mediterranean and seems to be completely absent from Greece." He then continued, "It is equally rare in Italy and in southern Spain," but noted that he had it from Algeria. In 1882 the same author, in his *Prodrome of European Orthoptera*, said merely that the species is not known in a wild state, and that in the last two hundred years it entered Europe from Asia. Miall and Denny in *The Cockroach* were more specific as to their understanding of the species, and said it "is native to tropical Asia and long ago made its way by the old trade routes to the Mediterranean



♂ ♂ ♀
FIG. 1. ORIENTAL COCKROACH¹

¹ Many entomologists and most pest control operators prefer the abbreviation "roach" for this and other specimens of domiciliary cockroaches. Oriental and German roaches have been seen by most citizens of the United States, who think that one is a roach and the other a water bug. It should be understood that "roach" and "water bug" are synonymous and that it would be desirable to discard the latter name.

In this and the other ten illustrations the insects are shown in their natural, or actual, size; thus, the sizes of the adults of the different species can be compared. Appropriately, the American roach is altogether superior to the Oriental and German roaches in size, appearance, and ability to use its wings in flight.

In most of the illustrations, two specimens are shown: male and female adults. In some figures the wings of a specimen are spread. In Figure 6 an immature form is also shown. For identification one of the following symbols is printed under each specimen: ♂ = adult male; ♀ = adult female, and X = immature form.—Ed.

countries," but why they so definitely fix its original home is not stated.

The passage of *Blatta orientalis* westward across Europe, like that of *Blattella germanica*, is well documented and need not be dwelt upon here. It is sufficient to know that into northern and north-central Europe this species quite definitely came from the East, and according to Lucas, in his *Monograph of British Orthoptera*, it had made its way to Holland and England by the time of Elizabeth. Early in the seventeenth century Swammerdam knew it in Holland, and in 1624 Moufet mentions it as occurring in wine cellars in England. There, however, its spread was much slower than on continental Europe, as Gilbert White, in 1790, speaks of it then as an unusual insect at Selbourne. As to the localization of its distribution in Mediterranean Europe to which Brunner referred in 1865, paucity of information at that time was probably responsible. Ignacio Bolívar, the distinguished Spanish orthopterist, in his 1898 *Synopsis of the Iberian Orthoptera* speaks of the species as "acclimated in the great part of Europe," without qualifying comment.

The most interesting and comprehensive summary to appear in recent years of the information then available on the native home of *Blatta orientalis* is contained in the posthumous work of Robert Shelford entitled *A Naturalist in Borneo*. For some years before his death in 1912 Shelford was our most promising student of the cockroaches, and in this interesting volume will be found many observations and conclusions assembled as a result of his residence at Kuching, where he served as Curator of the Sarawak Museum. He wrote:

[*Blatta orientalis*] has not been met with in a truly wild state until quite recently; the first specimens that were found were caught in houses, and though it has always been assumed that it was imported into Europe from the East, I am not aware that it has ever been found in Asia except as an unwelcome guest in human habitations. The discovery (by von Adelung) of specimens in the Crimean peninsula living under dead leaves, vegetable detritus and stones, in woods and copses far from any human habitation, is a fact of considerable interest, and it is perhaps permissible now to regard Southern Russia as the centre whence this ubiquitous insect has spread.

My personal interpretation of von Adelung's find is that the original home of the species was not located, but instead a "way station" on an ancient line of travel, where the species doubtless has been established for centuries. My reason for so believing is that no wild species related to *Blatta orientalis* is known from Europe.

Taxonomic studies of the Blattidae of Africa, with which I have been engaged for a number of years, have brought to light several previously undescribed, wild, close relatives of *Blatta orientalis*; one from Uganda, another from Kenya Colony. Like these species, all the other wild forms properly referable to *Blatta* as now restricted—which means all except *B. orientalis*—are African, ranging southward to the Cape of Good Hope and west to the Cameroons. Examinations of large series of as yet unreported Oriental Blattidae disclose no specimens of species of *Blatta*, and the literature, as mentioned by Shelford, gives no concrete information on the occurrence of *orientalis* there, except in a few large ports serving a world commerce. All indications are that *orientalis* does not thrive in the true lowland tropics, and the only parts of South America where the species seems to have been well established for many years are Chile and Argentina, neither of which is truly tropical. Philippi recorded *orientalis* (under a synonymic name) from the former country as early as 1863. Other early American occurrence records were from Jamaica in 1842 by Sell, from Guadeloupe in 1837 by Lherminier, and from Honduras in 1868 by Walker. There has been nowhere in tropical America as complete occupation of a country by *orientalis* as in the U. S.

Turning back to Africa, the records of *orientalis* show that, except for its presence at Windhoek in Southwest Africa, at Cape Town, and in Natal—these clearly detached colonies established by commerce—it came from Morocco, Algeria, Tunis, Tripoli, Cyrenaica, Egypt, and Somaliland. Finot has reported the species in Tunis as occurring in desert encampments. The North African material which I have examined is from localities reaching from Mogador, Morocco, to the Sinai Peninsula.

From the positive and negative evidence now available, I feel justified in concluding that *Blatta orientalis* was originally a native of North Africa, and that it probably found its way into eastern Europe in Greek, or even Phoenician, vessels, spreading into Byzantium, Asia Minor, and the Black Sea region, and thence slowly northward and westward over the remainder of Europe. The colonies in Chile and Argentina were doubtless established by way of Spain; where it probably was introduced from Moorish lands in North Africa long before the species, in its westward spread over most of Europe, had reached adjacent France. Over most of the continent of North America *orientalis* is as much at home as in Europe, but in the more humid southern United States it yields its usual role quite generally to the species of *Periplaneta*. Similarly in the humid tropical areas of South America *orientalis* has made little headway, and there it is not the domiciliary problem which the *Periplanetas* are. In brief, *orientalis* seems to have been derived from an area which combines summer heat and moderate winter cold, as the species can stand more of the latter than the *Periplanetas*, yet is not adapted to conditions of tropical or subtropical humidity. I have little doubt that comprehensive work in North Africa will disclose *Blatta orientalis* living under the same conditions of freedom from dependence upon human habitations as noted in the Crimea. Certainly the nearest known relatives of *orientalis* are wild forms of east-central Africa.

PROBABLY the most ubiquitous species of cockroach, and one certainly as well known as the Oriental Cockroach, is the so-called German Cockroach, or Croton Bug, (*Blattella germanica*) (Fig. 2). There are many other names for it; the English call it Shiner or Steam Fly; in Russia it has been called the "Prussian," and in Prussia it was known as the "Russian." Its steady spread across Europe was very similar to, but definitely more recent than, that of the Oriental Cockroach. In England it seems to have become broadly established only by the middle of the last century, and, according to

an anonymous writer quoted by Miall and Denny, was supposed to have become established at Leeds by means of bread baskets of soldiers returning from the Crimean War. Burr, writing in 1936, says it had been established in England for a century. Brunner in 1882 quoted Fischer de Waldheim to the effect that the species occurred feral at Moscow, and that it was similarly present in Thuringia, Saxony, the Hartz Mountains, in Westphalia, and at Kloster Neuburg near Vienna. Brunner then added, however, that he had never found it in a wild state. In 1898 Ignacio Bolívar stated that it was encountered in all of the Iberian peninsula and the remainder of the Mediterranean littoral.

As with *Blatta orientalis*, most authors give the original home of *germanica* as "Asia," and consider that it reached western Europe across Russia and Germany.

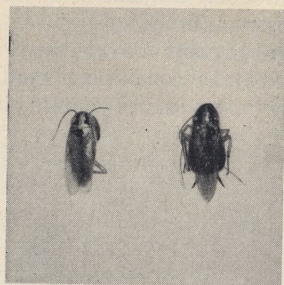


FIG. 2. GERMAN COCKROACH

The very imperfect appreciation, until recent years, of generic limits in the complex group or genera to which this species belongs makes any deductions on the basis of generic distributions as of the literature prior to 1910 virtually valueless, as *germanica*, before that time, was considered a member of an enormous, entirely unnatural "blanket" genus, now more logically broken into a considerable number of components and even into several genera groups. Thus the evidence of closely related species as indicators of the probable original home of *germanica* is our sole reasoning point. Purely historical information, of course, is not available, except as to its spread in the last century or so.

We have in the Oriental region a limited

number of species now generically associated with *germanica*, but all of these show very definite morphological differences, and none is from what is generally assumed to be the "Asia" of ordinary language; that is, Central Asia. Instead they are Indo-Iranian and chiefly Indian in distribution. On the other hand, in northeastern Africa, from between the great African lakes and Eritrea and the Anglo-Egyptian Sudan, occur fifteen distinct species intimately related to *B. germanica*, which also occurs there as well as westward across northern Africa, much as does *Blatta orientalis*, although *germanica* is also of broader establishment at many localities in the most tropical parts of the continent.

Therefore it would seem that the early human associated history of *Blattella germanica* is essentially the same as that of *Blatta orientalis*: From northeastern Africa it was transported by Greek or Phoenician vessels to Byzantium, Asia Minor, and the region of the Black Sea. In much of southern Russia it remained for centuries until the gradual opening up of occidental commerce with that country, probably after the Thirty Years War, made the passage of the species westward a possibility. It then spread gradually over western Europe and thence to America, and by commerce to virtually all parts of the world. The tolerance by this species of many conditions apparently not acceptable to *Blatta orientalis* has made its distribution much more cosmopolitan than that of the larger species.

THE cockroach genus *Periplaneta* is made up of a number of fully winged and active species, of which at least three have become domiciliary in habits, and two of these are outstanding pests in tropical, subtropical, and even warm temperate areas of virtually the entire world. These are the so-called American Cockroach (*Periplaneta americana*) (Fig. 3) and the equally poorly named Australian Cockroach (*Periplaneta australasiae*) (Fig. 4). In the United States the first of these is found quite generally as a domiciliary insect over most of the warmer, more southern area, frequently taken as far north as New England, but to the northward only under definitely protected conditions.

The Australian Cockroach is more partial to consistently warmer conditions and can exist continuously over much of the United States only under conditions of maintained warmth.

Most of our older, and some modern, authorities assumed that Linnaeus and Fabricius respectively were correct in the implications of the names they gave to these

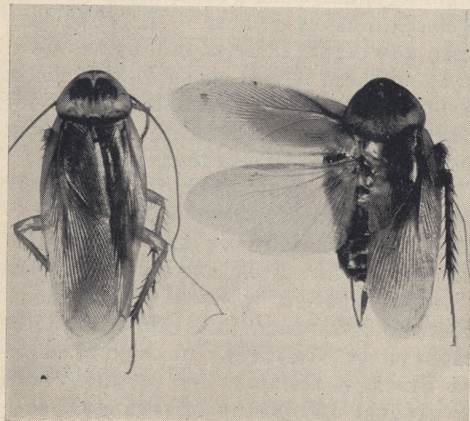


FIG. 3. AMERICAN COCKROACH

species; i.e., that the first originated in America and the second in Australia. It is yet asserted regularly, and with rather monotonous unanimity, that *americana* is native to tropical America and that *australasiae* came from the Antipodes. However, the far-seeing Shelford questioned this in his *Naturalist in Borneo*, saying, "it is certain that *australasiae* is only a rare immigrant to Australia, and I believe that tropical Africa or perhaps South-Eastern Asia was its original home."

No nondomiciliary species of *Periplaneta* occurs in the New World, except for the localized occurrence in our southeastern states of one species clearly introduced, which can be found in a variety of situations, as in houses, about buildings, under signs or on wharves, but always within the limits of cities or towns. The exact origin of this species is still uncertain, and it is as yet unknown from the nearby West Indies. Native nondomiciliary species of *Periplaneta* occur in many parts of tropical and southern

Africa and in the Indo-Malayan region. The nearest relative of *Periplaneta* is *Pseudoderopeltis*, which is a dominant and peculiarly African genus with a score or more species, occurring from Senegal and Egypt to the Cape. Throughout tropical Africa both *Periplaneta americana* and *australasiae* occur almost everywhere under domiciliary conditions, and in the vicinity of, as well as in, buildings, huts, and shelters of all kinds. Both are now very abundant in tropical America under domiciliary conditions, but there they are not as frequently encountered outside of human structures as in tropical Africa, as I can testify from personal experience across the width of Central Africa, in the West Indies, as well as in a number of countries of Central America and several of South America. Apparently, the occasional European records of these two species have been due to individual commercial introductions and not to sheet infiltration as in certain other species.

From our present knowledge, I feel we are warranted in concluding that, though *Periplaneta* also occurs native in Indo-

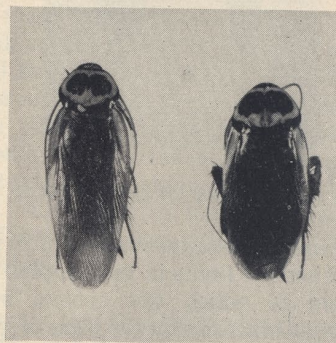


FIG. 4. AUSTRALIAN COCKROACH

Malaysia as well as in Africa, the evidence points more directly to tropical Africa as the original home of *Periplaneta americana* and *australasiae*, and perhaps the less frequent *P. brunnea* as well. Slave ships from the West African coast, continuously moving for nearly two centuries, doubtless provided the means of introduction into South America, the West Indies, and the southern United States. The flying ability of *Peri-*

planeta, which is often exercised and by both sexes, has furthered the broadening of distribution when colonies had been established. The sole controlling factor with these species seems to be the maintenance of temperature above a certain minimum. Along the periphery of their distribution they can survive only under protection in greenhouses and similar uniformly heated places.

PERHAPS the most pleasingly patterned of our domiciliary cockroaches is *Supella supellectilium* (Fig. 5), for which the vernacular name Brown-banded Cockroach is the most appropriate of several which have been used. First described by Serville from Mauritius, it was, as its specific name indicates, recognized by him as a household form. The species is now known from a considerable part of the tropics and subtropics of the Old World, although apparently much less evenly or broadly distributed to the eastward than it is over eastern, southern, and northeastern Africa. It was introduced into the West Indies probably by slave ships and first recorded there in 1862 by Saussure, the great Swiss orthopterist, as the synonymous *Blatta cubensis*. A few records are available of its occurrence at coastal points in South America, but it is not at all broadly established there or in Central America. From the United States I first reported it in 1903 as taken at Miami, Florida; doubtless introduced from Cuba, where it is quite abundant in houses. In 1912, with my colleague Mr. Morgan Hebard, I found it common in a fruit store in Key West, and in recent years its distribution in the United States has been steadily extended, so that today it is known to occur under domiciliary conditions as far northeast as Philadelphia, westward to San Bernardino, California, and in the interior northward to Nebraska. Shipments of fruit from Florida have probably provided a ready means for distribution in our territory.

The genus *Supella* is now under critical taxonomic study, and there are yet to be properly characterized a number of native African species living under natural condi-

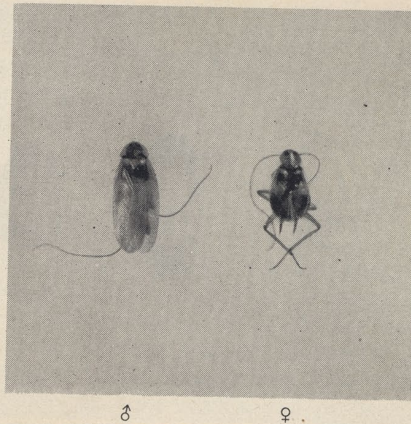


FIG. 5. BROWN-BANDED COCKROACH

tions and not dependent upon human habitations. The species *supellectilium* is distributed over much of Africa outside of the Guinea forest areas. No nondomiciliary species of *Supella* is known except from Africa, and it is therefore quite reasonable to conclude that the genus, hence the species *supellectilium*, is of African origin, and that slave ships probably were responsible for its American introduction.

THE most widely distributed member of the blattid subfamily Panchlorinae is a species which possesses no accepted vernacular name, but which may be called the Bicolored Cockroach (*Pycnoscelus surinamensis*) (Fig. 6). Supposed by Linnaeus to be of American origin, he gave to it the specific name *surinamensis*. While the subfamily Panchlorinae has many endemic American species and a considerable number of genera so limited, *Pycnoscelus* is clearly not one of these. The species *surinamensis* is virtually world-wide in distribution within the humid tropics and subtropics and is less likely to occur within doors than under stones, boards, tiles, dead palm trees, or any other loose litter or trash about houses or stables. It has also been taken from under the bases of living palm leaves, in bromeliads, under boulders away from houses, in rotted logs, in cracks of semidried mud and in the litter of wood-rats' nests. The very different-looking immature stages are often found burrowing in topsoil. Within the United States

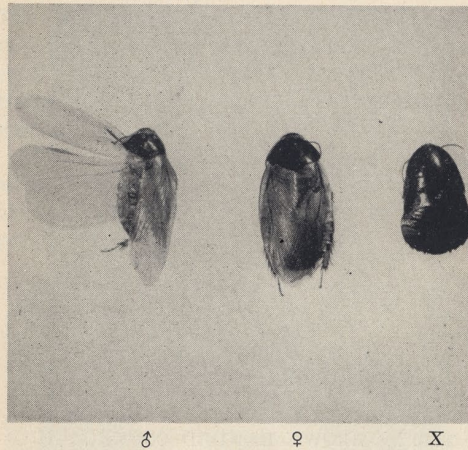


FIG. 6. BICOLORED COCKROACH

surinamensis has been reported as established outdoors in peninsular Florida, in Louisiana, and in southern and south-central Texas. In greenhouses and similar places with artificial heat during cold weather it may occur as far north as New England.

This widely spread *Pycnoscelus* has one peculiarity which may have a confirmatory value in establishing its original home. Virtually everywhere in the Western Hemisphere, and probably in other areas in which it occurs, the species is apparently parthenogenetic. As yet I do not know of an adult male specimen taken under condition of nature in the New World, the single case brought directly to my attention being a male captured in the greenhouses of the New York Botanical Garden, the source medium for which may have been a recent importation of Oriental shrubs. As far back as 1865 Carl Brunner noted in the series of *surinamensis* before him that the only males were from the East Indies, none being included in his tropical American representation. In 1893 the same author said he had seen additional males from Burma, but still none from the New World. Hebard in 1916, examining much larger series than Brunner had seen and from a considerable number of localities, noted only one male from Lombok in the Lesser Sunda Islands. In 1927 Rehn and Hebard found no males among fifty adult specimens from twenty-four West Indian localities. Since that time

series totaling many hundreds of specimens from a very large number of localities have been examined by me. Males were found only in Oriental representations.

In Indo-Malaysia occur other endemic species of the genus *Pycnoscelus*, none of which ranges over more than that general area. This, taken with the inference which can be drawn from the localization of males of *P. surinamensis*, leads one to the conclusion that this species is of Oriental origin, and that it owes its present wide distribution to commercial transport, augmented by its habit of hiding in soil, thus making possible its transfer with plant stock earth. Its introduction into Africa may have been due to Arab traders, who for a considerable time before the Portuguese reached the East coast of Africa had carried on an extensive commerce across the Indian Ocean to the east. Again, its introduction there may have been due to the Portuguese voyageurs themselves. In western Mexico it may have been introduced in Spanish galleons from the west, as discussed under *Neostylopyga rhombifolia*. For most of tropical America on the Atlantic side slave ships probably furnished the means of introduction, as they did with so many other species of insects brought from Africa. With accumulated litter and trash slave ship holds carried to America many undesirable immigrants. Possibly the introduction of *surinamensis* into the United States was a secondary one from the West Indies, where the species is known to be firmly established in all of the Greater Antilles and a number of the Lesser group.

In 1926 Fielding showed that in Australia *Pycnoscelus surinamensis* is the intermediate host and agent for the transmission of chicken eye worm (*Oxyspirura parvovum*). The parasite was found to be present in both the abdominal and thoracic cavities, as well as in the legs of the cockroach, and passed to the fowl almost immediately after *Pycnoscelus* reached the bird's crop.

A LARGER and quite striking member of the subfamily Panchlorinae is the so-called Madeira Cockroach (*Leucophaea maderae*) (Fig. 7), which is broadly established in the West Indies and in coastal Brazil, with more

recent and localized colonizations in Central America, but in the United States has as yet been taken only as an adventive brought in on bananas or similar shipments. In all probability it eventually will become established in our Southern States, as it is universally prevalent in Cuba, Jamaica, Hispaniola, Puerto Rico, and the Bahamas, where



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FIG. 7. MADEIRA COCKROACH

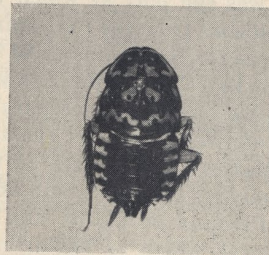
it frequents habitations, warehouses, and other structures. At times it is a very abundant and serious pest.

Palisot de Beauvois first reported this insect from America in the early years of the nineteenth century, presumably from Hispaniola. He then stated his belief that it originated in Africa, and that it was imported into the French colonies in America. In all the Greater Antilles and a number of the Lesser ones, as well as in the Bahamas and the Virgin group, the species is now thoroughly established. Outside of tropical America and tropical Africa *maderae* is also known from Madeira, the Canaries, Morocco, Andalusia in Spain, and Corsica, doubtless as infiltrations in colonial commerce with West Africa. In Asia and the Pacific Islands it is known only from Java, the Philippines, and the Hawaiian group. Its presence in Java and the Philippines can be explained by accidental colonial introduction from Africa, either directly or secondarily from the Canaries or the western Mediterranean region, and in Hawaii by

more recent transplanting, probably from the Philippines. The absence of the species from India, Australia, southern China and the greater part of Malaysia attests its non-endemism there.

The other five members of the genus *Leucophaea* are entirely tropical African in distribution, and *maderae* also occurs over most of that continent south of the Sahara from Senegal to Kenya Colony and to Angola and Natal. A very closely related species is restricted to West Africa between Liberia and the Gabon. It appears very probable to me that *maderae* was originally a native of West Africa, and probably that portion usually spoken of as Upper Guinea, where it commonly occurs today and where its nearest ally (*L. puerilis*) is also found. Slave ships doubtless brought the species to the West Indies and the coast of Brazil prior to 1800, thus establishing it in the New World.

PROBABLY the most bizarrely marked domiciliary species is the Harlequin Cockroach (*Neostylopyga rhombifolia*) (Fig. 8). Both sexes of this strikingly patterned species are flightless, the tegmina, or forewings, being but short, lateral, articulate, but functionally useless, slips, while the hind wings are absent. Male individuals of *rhombifolia* ordi-



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FIG. 8. HARLEQUIN COCKROACH

narily occur much less frequently than females, but we have no evidence that males are unnecessary for reproduction as in *Pycnoscelus surinamensis*.

The first record of *rhombifolia* from the New World was of its occurrence at Acapulco, Mexico, in Venezuela, and in Argentina (Brunner 1865). In 1893 Saussure and

Zehntner reported it from Brazil. There has been little amplification of the other New World records in recent years, but the west Mexican colony has been productive of a spread of the species along the west coast of that country, northward over Sinaloa, and even to Nogales on the Sonora-Arizona line, as well as its establishment for nearly fifty years in the southern part of Lower California.

The species *rhombofolia* is abundant over the greater part of the Indo-Malayan region, particularly in the Philippines. It is also found in the Hawaiian Islands, probably as an introduction in recent years from the Philippines, and it is also quite general in Madagascar, Mauritius, Rodriguez, in the Seychelles and adjacent islands, and along the eastern coast of Africa, there extending inland along trade routes to Nyasaland and the Zambesi valley, while it has also been reported from Madeira. The last is probably an isolated colony established by a chance introduction on a Portuguese ship Europe-bound from the Indian Ocean.

What particularly interests us is the introduction of the species on the west coast of Mexico a matter of more than eighty years ago. Very probably if the species becomes established as a domiciliary insect in the United States it will be from this colony. Acapulco was the port at which the classic Spanish galleons from the Philippines landed their cargoes for land transfer to the Atlantic side, to be reloaded for Spain. Rather curiously, we have an exact parallel to the problem of *Neostylopyga rhombifolia* in western Mexico in the cases of the legless lizard, *Typhlops braminus*, and of two other reptiles, *Peropus mutilatus* and *Hemidactylus frenatus*, which, as Taylor has recently shown, were certainly introduced from the Philippines into western Mexico, and in all probability by way of the galleons reaching Acapulco. There can be little question that this now broadly spreading colony of *Neostylopyga* was an additional galleon immigrant.

The Indo-Malayan region was clearly the original home of *Neostylopyga rhombifolia*, and the occurrence of the species even on the east coast of Africa is certainly due to the inadvertent agency of man.

A PRETTY domiciliary species of much of the tropics is the Cinereous Cockroach (*Nau-phoeta cinerea*) (Fig. 9), which, although not as yet found in the United States, is known from Cuba, Hispaniola, Mazatlan in Mexico, Brazil, and the Galápagos. Its introduction into the United States is quite conceivable when the breadth of its present world cover-



♂ ♀
FIG. 9. CINEREOUS COCKROACH

age is considered. In Indo-Malaysia it is broadly if not solidly distributed—in the Philippines, Sumatra, and Singapore—and it also occurs in Australia, while eastward it has reached New Caledonia and the Hawaiian Islands. It also occurs in Madagascar and Mauritius, and its East African records reach from Egypt, through the Sudan (where it occurs even in the huts of the Shilluk natives), to eastern Tanganyika. It has also been reported from the Transvaal and Natal, and there is one record from the Cameroons in West Africa.

In a recent detailed study of the African distribution of this and certain other African species of the genus, it is concluded that its native home was East Africa, that it spread to the Malagasy region probably through the medium of Arab trading ships, and that the more distant Philippine and similar Oriental centers were established through Portuguese or Spanish voyageurs. From the Philippines the western Mexican colony was probably founded by transport, in Spanish galleons, as with *Neostylopyga rhombifolia*, already discussed, that in Brazil by Portuguese traders on long voyages with well-established ship colonies of *cinerea*, while the Galápagos population doubtless was due

to camps of tortoise-hunting seamen from ships of numerous nationalities. The Cuban and Hispaniolan representatives may have come from the west in goods brought from the Philippines via Mexico, as the Atlantic galleons often called at Cuban or Hispaniolan ports in the sixteenth and seventeenth centuries.

AN INTERESTING case of localized introduction of a domiciliary species is that of the Buprestid Cockroach (*Oxyhaloa buprestoides*) (Fig. 10), which is a widely distributed African species, now long and thoroughly established in a localized territory in eastern Cuba. The genus otherwise is Ethiopian in its range. Most curiously the first technical name applied to this species, and that which we must use for it, was based on Cuban material, which, however, is entirely inseparable from very extensive African representations now available. Certainly the species was established in Oriente Province, Cuba, prior to 1862, but *buprestoides* has not as yet extended its range in Cuba over more than the eastern part of the island, although in tropical Africa, as I know from personal experience, it is widely distributed and abundantly represented. In 1893 Saussure and Zehntner reported the species from Mexico

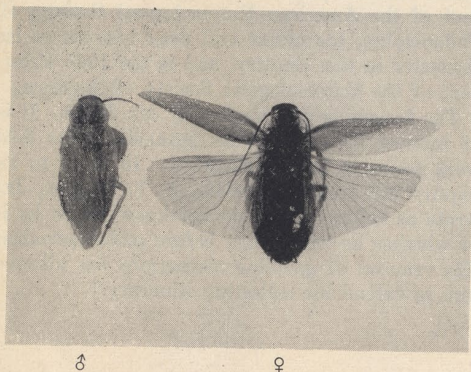


FIG. 10. BUPRESTID COCKROACH

and Guatemala. These specimens more probably represent immigrants from the Cuban colony, possibly through the port of Santiago, than direct introduction from Africa. While *Oxyhaloa buprestoides* is widely distributed over tropical Africa, it has not been reported from the Oriental region, the Amer-

ican localities being the only extralimital ones, if that word may be used. I feel no hesitation in concluding that the New World occurrence of the species can be traced directly or secondarily to slave ship introduction from the West African coast.

ANOTHER quite attractive domiciliary cockroach is one for which no vernacular name has been used, but which may be called the Pale-bordered Cockroach (*Leurolestes pallidus*) (Fig. 11). It was described from and

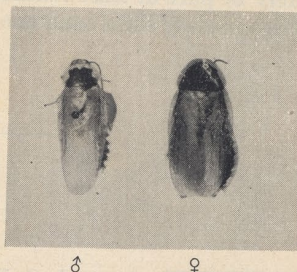


FIG. 11. PALE-BORDERED COCKROACH

is common in Cuba, where it is found all over the island in houses, under lockers, boards, etc. It also occurs in Jamaica, Hispaniola, Puerto Rico, and certain of the Lesser Antilles. It has been recorded from Mexico, Guatemala, and Brazil, as well as the Canary Islands and southern Florida, where it has been encountered in Key West and on Key Largo. At Key West Hebard and I found it in a fruit store associated with *Blattella germanica*, *Periplaneta americana*, and *Supella supellectilium*, which gives an idea of its ecological associates.

I believe the occurrence of *pallidus* in the Canaries is due to colonization from the West Indies, and that the species, and incidentally the genus, is of West Indian origin. In *Leurolestes* we have, I am convinced, a reversal of the usual flow of blattid immigration; that is, movement from instead of to the West Indies.

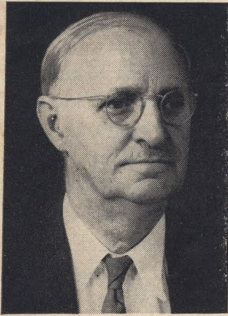
OF THE preceding eleven domiciliary species of cockroaches, five (*Periplaneta americana*, *P. australasiae*, *Supella supellectilium*, *Leucophaea maderae*, and *Oxyhaloa buprestoides*) very definitely reached America by the slave ship route from West African

sources; another (*Nauphoeta cinerea*) is also of African origin, but in part at least reached America by a more circuitous route; one (*Neostylopyga rhombifolia*) was probably of Indo-Malayan origin, or at least came from the Indian Ocean area; two (*Blatta orientalis* and *Blattella germanica*) almost certainly reached America directly from Europe, which, however, represented a way station on the long trek of these originally north or northeast African types; one (*Pycnoscelus surinamensis*) is of Oriental origin, but probably in part at least reached America via Africa in slave ships; and one (*Leuro-*

lestes pallidus) is an endemic West Indian type, slowly spreading by commerce into southern Florida and other parts of the American tropics and subtropics.

Another ten years of careful checking on the presence in various parts of the world of certain of these fellow-travellers of humanity may greatly amplify our knowledge of what might be called the prehistory of their wanderings, but the basic conclusions here presented represent the results of some decades of careful study, and probably will be strengthened, rather than contradicted, by information yet to be secured.

JAMES A. G. REHN



JAMES A. G. REHN, Curator of Insects at the Academy of Natural Sciences of Philadelphia, was born in Philadelphia, in 1881. A boyhood interest in zoology eventually crystallized into a life-time application to entomology. Appointed in 1900 a Jessup Fund Student at the Academy, his life

has been spent continuously at or in the service of that historic institution, of which he also has been Secretary or Corresponding Secretary for twenty-five years. His published entomological researches upon the systematic, distributional, and phylogenetic aspects of the Dermoptera and Orthoptera, the special fields of his work, total approximately three hundred titles. In develop-

ing the largest existing collection of these insects at the Academy, a considerable portion of his life has been spent in contributory field work, involving the entire United States, portions of Central and South America and the West Indies, and a cross section of Central Africa. In 1940 he served as Secretary of the Biological Sciences Section of the Eighth American Scientific Congress. For the past few years he has been President of the American Entomological Society, of Philadelphia, the oldest and most historic of its character in this country, and is the 1945 President of the Entomological Society of America.

The foregoing was written by Mr. Rehn. It is of interest to add that his enthusiasm for field work seems to be undiminished. In reply to an inquiry Mr. Rehn's associate, E. T. Cresson, Jr., wrote as follows: "We do not know where he is or whether he will return before mid-September. The removal of gasoline restrictions has allowed him to extend his collecting itinerary."