BIOLOGICAL NOTES ON ARACHNOCORIS ALBO-MACULATUS SCOTT (HEMIPTERA; NABIDAE)[1]

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In 1881 John Scott described as two new species of a new Nabid genus some South American insects which were sent to him by the araneologist, Pickard Cambridge, accompanied by a note that "they were found living *en famille* with colonies of spiders." In 1890 Reuter formed for this genus a distinct subfamily which, however, in 1908 he rejected on the discovery of *Parachnocoris*, a genus from Demevara evidently connecting *Arachnocoris* with the more typical members of the subfamily Nabinæ (Reduviolinæ). Meanwhile, Bergroth in 1899 described a third species from South America, discovered by Simon, the French araneologist. Later, in 1914, Bergroth published a further note on the genus with a description of a fourth species from South America and some valuable revisional data. Uhler's species, *Velidia berytoides*, from the West Indies and Distant's *Herdonius* (?) *panamensis* from Panama were both shown, by comparison of the types in the British Museum to belong to *Arachnocoris*. The distribution and extent of the genus were thus fully elucidated, but nothing of the nature of biological data was added. Finally in 1916 Bergroth described *A. trinitatis* from Trinidad, bringing the number of known species up to seven, which in this paper by synonymy is reduced to six. The range of the genus as now understood includes South America as far south as Brazil (Rio Janeiro), Panama, the island of Trinidad, and Grenada (West Indies). It is thus essentially neotropical.

To Drs. W. M. Wheeler and Nathan Banks I am indebted for the opportunity of describing the nymph for the first time and

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of recording some additional biological data of great interest. Their material comprises eight males, nine females and four nymphs, taken together in the same spider webs and obviously conspecific.

Nomenclature.—There is some confusion as to the correct name of the present species. Scott's description of the Brazilian *A. albomaculatus* agrees with that of Distant's *A. panamensis* (described in the Mirid genus, *Herdonius* Stal) except that the middle femora of the former are said to be incrassated and the middle tibiæ curved and basally thickened, while *panamensis* is normal in these respects. There is also slight divergence in coloration. The present material might be identified with either species since the above structural characters are present in the males and absent in the females. There would therefore be no hesitation in synonymising *albomaculatus* and *panamensis* were it not that no less an authority than Bergroth (1914) having examined the unique types in the British Museum, concluded that they were distinct, since the types of both are males and the incrassated middle femora can thus not form a mere sexual character. A study of the present series shows, however, that the sexes are much less easily distinguished than in more typical Nabidæ, while the colored figure of *A. panamensis* given by Distant in the *Biologia* seems an admirable representation of the female of the present species. The indications are therefore that *panamensis* is a synonym of Scott's earlier species. This conclusion is supported by Bergroth's own statement that he has received a specimen of the true *albomaculatus* from Panama, and by the fact that Reuter (1890, p. 293) on the other hand recorded a Rio Janeiran specimen which agreed apparently in every respect with *A. panamensis*. Mr. W. E. China has kindly examined the types, and has written under date 21, Nov. 1924, "*A. albomaculatus* Scott is a ♂. *A. panamensis* Dist. is an ♀. I consider that they are the two sexes of the same species. . . ."

Arachnocoris albomaculatus Scott

Advanced nymph.—(Figures 1 and 2.) Shape very like that of a long-legged ant, but the long, almost filiform antennæ rather detract from this resemblance. Metathorax and more so the anterior abdominal segments much constricted like the petiole

of an ant. Dorsally the immediately post-basal abdominal segments form a conspicuous rounded swelling like the scale on the petiole of an ant. General color shining reddish brown, abdomen darker.

Head and pronotum reddish brown, the latter with a median pale longitudinal streak extending on to mesonotum. Mesonotum paler. Eyes red.

Anterior half of abdomen including the constricted portion whitish with four transverse crimson bars, the petiolar "scale" brown, and the connexivum transparent except where crossed by the crimson bands; this portion of the body thus looking even narrower than it really is. Posterior half of abdomen deeper castaneous with three rather more chitinised plates black. Scent-gland orifices in minute indistinct dark areas anterior to these plates. Anal segment yellowish with a black ring.

Ventral surface of head and thorax yellowish brown tinged in places with red; abdomen reddish with four very distinct heavily chitinised plates nearly black. Apex of mesepimeron and to a less extent of mesepisternum sharply marked off in ivory white.

Antennæ brownish, first segment much paler medially, second with dark distal half but actual apex pale, third uniformly dark brown, fourth dark at base and apex.

Rostrum brownish, darker distally.

Legs reddish brown, trochanters and bases of tibiæ whitish, apices of tibiæ, bases and apices of tarsi infuscated.

Head shorter than pronotum, about as long as wide, wider behind than in front of eyes; post-ocular part about half as long as long diameter of eye, with pale impressed line extending mesad from the inner angle of each eye (much as in *Nabis subcoleoptratus* Kirby). Caudad of this line in some specimens (older ?) are two dark spots corresponding in position to the ocelli of the adult except that they are rather closer together. Rostrum almost reaching hind coxæ, first segment short, second four-fifths as long as third, third long and slender, fourth less than half length of third. Clypeus elevated, antennæ inserted rather low. Antennæ not quite as long as body, basal and apical segments somewhat thicker than the two intermediate ones; comparative lengths as 2 : 3 : 4 : 3; sparsely and shortly haired.

Pronotum one and a half times as wide as long; greatest width posterior to middle and exceeding that of vertex including eyes; posterior border almost straight, with a collar indicated only laterally; posterior border somewhat excavated but with a median projection.

Mesonotum as long as pronotum, somewhat convex; wider than pronotum. Scutellum indicated by small white projection. Hemielytral pads reaching base of "scale" on petiole, closer together at apex than at base.

Metanotum in middle only one-third length of mesonotum. Whole metathorax strongly constricted.

Abdomen oval, pointed caudally; basal segments strongly constricted and provided dorsally with a prominent rounded knob, the whole base simulating the petiole and scale of an ant. Abdomen convex dorsally and exceedingly so ventrally. The whole dorsal surface shows a marked weakness of chitinisation, the only tergites chitinised in a normal manner being the three posterior ones, and these are so reduced in size that I was at first uncertain how to interpret them.

Fore coxæ extremely long. Both fore and middle femora somewhat thickened, and supplied ventrally with two irregular rows of short, stout black bristles. Fore and middle tibiæ about as long as the respective femur and trochanter. Hind femora shorter than hind tibia as 7 : 9. Tarsi 2-segmented, the basal segment short.

Length of body, 3.8–4.0 mm.

Barro Colorado Island, C. Z., Panama; taken with 17 imagines, 13th to 31st, July, 1924, W. M. Wheeler (nos. 721, 802), N. Banks. The four nymphs vary somewhat in size, especially in the abdomen, but judging by the hemielytral pads all are in the same stadium. Bergroth (1921, p. 86) believes that *Nabis* has six nymphal instars. If *Arachnocoris* also has six then the instar just described is either fifth or sixth.

I have compared these nymphs very carefully with the description of nymphal *Nabis* (*Reduviolus*) *subcoleoptratus* Kirby as given by Bergroth (1921, pp. 85–87). The agreement in subfamily characters is very close and both species resemble ants to a remarkable degree; but the appearance is brought about

largely in a different manner in the two species. Thus Bergroth writes of *N. subcoleoptratus*, "Zu der Ähnlichkeit im Profil tragen wesentlich bei die aufgebogenen hinteren Seitenwinkel des Metanotums, welche die aufrechstehende 'Schuppe' der Ameisen vortäuschen." But in *Arachnocoris* the striking similitude of the formicine scale is produced in no sense by the metanotum but entirely by the basal portion of the abdomen.

Imago.—Scott's detailed description is good except so far as the rostrum is concerned and Reuter (1890, p. 293) has corrected this point. The males in the present material differ from Scott's description in that the pronotal collar is black instead of brown and the margin of postero-lateral angles of pronotum is narrowly edged with white—a character not mentioned by Scott but given by Distant in *A. panamensis*. In this connection Mr. W. E. China writes, "*A. albomaculatus* Scott has the posterior lateral margins of the pronotum narrowly pale."

The practical absence in the adult of the normal Nabid thickening of the anterior femora in both sexes is remarkable. Reuter (1908, p. 129) seeks to explain it in the following sentence: "Der von den übrigen Reduviolinen abweichende Bau der Beine, deren vordere Schenkel nicht dicker als die übrigen, ist wahrscheinlich eine ökologische Anpassung; die Arten dieser eigentümlichen Gattung sollen, nach Scott, in den Nestern der Spinnen symbiotisch leben." Apparently Reuter thought that the prey is probably rendered more or less helpless by the webs and powerful raptorial fore-legs are not necessary. Only close observation in the field can, however, settle these points.

The tarsal claws are remarkably modified. Those of a typical Nabid, *e.g., Nabis capsiformis* Germ., are very long and slightly curved (Figure 4). The claws of *Arachnocoris*, on the other hand, are relatively much smaller, straighter and capable of being appressed much closer to the tarsus, in a position which appears to be normal to the species, and which forms efficient hooks doubtless enabling the insect to walk suspended upside-down from spider webs as observed by Drs. Wheeler and Banks. As the latter observer remarks they could not possibly progress in any other way on the single strands which make up the labyrinth of a Theridiid web.

The color scheme of *Arachnocoris* is worthy of remark. The ground color is black or a deep purplish black, relieved with glistening silver or china white on the posterior lateral margins of the pronotum, upturned apex of scutellum, middle and apex of corium, bases of hind tibiæ, and ventrally on the whole of the swollen, strongly chitinised porcelain-like gula, apices of episterna and epimera, a band on the abdominal pedicel, the posterior margins of some of the basal abdominal segments and finally on a row of five embossed spots arranged segmentally on each side of the basal half of abdomen. These segmental spots are probably connected with abdominal stigmata 1 to 5. The orifice of the odoriferous gland is marked by an abrupt squarish elevation, jet-black tipped with white. White markings of this peculiar quality are rare in the Heteroptera and contrast very strongly with the drab coloration of more typical Nabids. At the same time they remind one forcibly of the color scheme in Argyrodes, a genus of Theridiid spiders which live as commensals in the webs of large orb-weaving spiders, and hang from the lines like dew-drops glistening in the sun. The same contrasted coloration with a similar silver-white occurs also, though to a less marked degree in certain of the orb-spinners which are accustomed to remain suspended in the center of their webs, *e.g.*, members of the genera, *Cyclosa, Nephila, Argiope.* It would seem then that a color scheme in which glistening silver is contrasted with dark color is characteristic of Arthropods which spend their lives suspended in spider-webs. The phenomenon is apparently comparable with the tendency of desert animals to become drab colored, of pelagic organisms to become transparent, and so on through all the other color correspondences between animal and environment usually ascribed to protective resemblance.

There is another aspect to the coloration of *Arachnocoris.* The general shape of the body in the imago, with the marked petiolation of the basal abdominal segments and the strong ventral convexity of the abdomen, produce a considerable degree of resemblance to an ant. This superficial similarity is strengthened by the white markings at the middle of the corium, where the hemielytra would otherwise obscure the basal abdominal constriction. There are thus two elements in the color scheme and body-

form of these bugs, one characteristic of exposed web-dwelling Arthropods generally, the other common in ant mimics. Of these the former is superficially predominant, but the latter has involved greater structural modifications. In the nymph also both elements are present but their relations are reversed, indicating probably that myrmecoidy is an older character of the species than is the habit of dwelling in spiders' webs—a view which is supported by the fact that the nymphs of more typical Nabids are often extremely myrmecoid.

Myrmecoidy of the nymph.—In the advanced nymph the contrasted black and white element in the coloration is only feebly represented by white markings on the sides of metathorax and base of abdomen, on a ground color which is predominantly reddish-brown, though the more strongly chitinised sclerites of the abdomen are almost black.

As indicated, however, by the figures, especially that of the profile, the nymph is extremely ant-like. The chief factor in this resemblance is the knob on the abdominal petiole. This is also a feature in the "mimicry" of ants by the nymph of *Nabis subcoleoptratus* as mentioned above. But the unexpected fact is that this structure is developed in a different manner in the two genera—in *Arachnocoris* by modification of one or more of the immediately post-basal abdominal segments; in *Nabis* by modification of the metanotum. Such achievement of a similar result by unlike methods brings the myrmecoidy of Nabidæ into line with that of other insect groups where the resemblance to ants is brought about in various ways; and may fairly be considered a strong argument against the view that the resemblance to ants is entirely accidental. It is nevertheless difficult to explain the myrmecoidy of *Arachnocoris* in terms of the mimicry hypothesis, of which one of the chief postulates is that the model must be plentiful in the situations frequented by the mimic; for *Arachnocoris* appears to be confined to one of the few stations which, in the forests of Panama, remain unfrequented by ants—namely, the interior of spiders' webs.

Habits of Arachnocoris.—The original observation of Pickard Cambridge that the members of this genus live *en famille* with colonies of spiders has been quoted and requoted by most sub-

sequent writers on these insects. The collections of spiders' webs in the angles between the buttresses of trees where the present species was taken hardly constitute colonies. Moreover in the webs of true colonial spiders at Panama, Dr. Banks was unable to find *Arachnocoris*.

Of most of the later described species no biological data have been recorded. The single known specimen of *A.* (*Velidia*) *berytoides* was collected "near shady bank of stream; beaten from mass of bush and decaying leaves." It is therefore uncertain whether or not it was in a spider web.

The specimens of *A. albomaculatus* on which this paper is based were collected in spiders' webs stretching between the buttresses on the bole of a large silk cotton tree (*Bombax ceiba*) near the Biological Station, Barro Colorado Island, Canal Zone. The webs were numerous and to a certain extent intermingled, so that it was by no means easy to ascribe them to the particular spider species, but Dr. Banks states that most were those of *Theridion fordum* Keyserling. More or less connected with the webs of this species were those of a *Uloborus*. Finally Dr. Wheeler has a specimen of the Gasteracanthid, *Acrosoma* sp. from the web of which was taken an Arachnocoris nymph and three adults. Mr. Banks noticed that all the bugs seen by him were in the *Theridion* webs, which not only predominated between the buttresses, but which would also be safer than the cribellate webs of the *Uloborus* or the sticky orb-webs of the *Acrosoma*.

It is remarkable that practically all the specimens were secured in webs between two buttresses only of this single tree. Although *Theridion fordum* webs were equally common on the boles of other trees of the same and different species, and were built also in other situations, no *Arachnocoris* were found elsewhere on the island.

Both observers noticed that the bugs hang upside down from the webs, a position for maintaining which their peculiar claws are eminently adapted. Such a position, habitually assumed, would also throw light on the strong convexity and heavy chitinisation of the gula (especially marked in the imago) and of the ventral surface of the abdomen. The latter is so marked in the

nymph (fig. 2) and the dorsal surface is so unusually feebly chitinised, that these two surfaces are almost as reversed in structure as they commonly are in space, when the insect hangs inverted from the web. A similar reversal of structure is said to occur in bats, as a result of their usually inverted resting position. Thus Kammerer (1924, p. 217) refers to "the remarkably inverted form of the stomach in bats, because the latter, when relaxing, hangs on with its feet, its head hanging downward" (sic).

The discovery that the nymphs also not only live in spiders' webs but are moreover modified rather profoundly for such an existence, indicates a probability that the whole life-history of *Arachnocoris* is spent in this peculiar situation and that the feeding-habits are commensal, but on these points more field observations will be necessary.

The only other case known to me of Heteroptera living in association with the webs of spiders is that of several species of thread-legged bugs, Reduviids of the subfamily Ploiariinæ, which frequent corners of sheds, fences and similar situations where cobwebs accumulate. They perhaps feed on insects caught in the webs. Thus Downes, quoted by Parshley (1921, p. 17) writes of *Ploiaria canadensis* Parshl., "numerous this year on the under side of a rail on the shady side of a close board fence which separates my garden from the adjoining lot. Here they were found in all stages living among the cobwebs and apparently getting their living from the insects caught in them, though I never actually found one feeding." Another Reduviid of the same subfamily, *Ploiariola morstatti* Schum., lives inside the web-nests of the Psocid, *Archipsocus textor* End., and preys on these insects (Schumacher, 1917). The habit of *Arachnocoris,* however, of dwelling actually in a spider web remains unique among the Hemiptera. Dr. Wheeler has noticed that it is paralleled by the commensalism of the Tineid moth, *Batrachedra stegodyphobius* Walsingham, with South African social spiders of the genus *Stegodyphus* (Pocock, 1903).

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EXPLANATION OF PLATE VI

1–2. *Arachnocoris albomaculatus* Scott. Advanced nymph.
3. id. Imago. Apex of tarsus showing claws.
4. *Nabis capsiformis* Germ. Apex of tarsus showing one of the claws.