A NEW TYPE OF CORIXIDÆ (RAMPHOCORIXA BALANODIS, N. GEN., ET SP.) WITH AN ACCOUNT OF ITS LIFE HISTORY.

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Our knowledge of the developmental history of the water bugs is very incomplete. In the early days of embryology, Corixa was studied by Metschnikoff,\(^2\) and Brandt,\(^3\) and others with especial reference to the germ layers, the revolution of the embryo, etc. Leon Dufour\(^4\) had previously described the eggs of the two European species, *Arctocorisa striata* (L) and *heiroglyphica* (Duf.).

The only account of the metamorphosis of any member of the group that I have been able to find is that of F. Buchanan White,\(^5\) who, in addition to describing the egg of *Corixa nigrolineata* ( = *Arctocerisa fabricii*), also described the first moult, remarking that the tarsus of the third pair of legs is but one-jointed. "At this stage," he says, "they died"—a result which apparently has been obtained by all who have attempted similar observations since. Indeed the rearing of both Notonecta and Corixa seems attended with unusual difficulties,\(^6\) although I believe that by the use of mosquito larvae for food, success has been attained with the former.

The writer has succeeded in carrying a species of Corixid through the whole series of moults from egg to imago, and since the critical study of the larger groups of Hemiptera is greatly hampered by our ignorance of the developmental stages, it seems worth while to describe the various instars in some detail.

The present species, which appears to be undescribed, has the remarkable habit of attaching its eggs to the carapace of the crayfish, some individuals of which were found almost completely covered by hundreds of tiny eggs. As the writer intends later to discuss this habit in detail, it will be merely alluded to here. The egg-bearing crayfish were captured in a small clear-water pond near Columbia, Mo., the early part of July and were isolated in small aquaria. All the eggs were in the same advanced stage of development, with the red eye spots showing through the shell, and they began to hatch July 8th (1910).

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1. From the Zoological Laboratory of Washington University.
4. Recherches sur les Hémiptères, 1833.

April, 1912
The mistake was made of attempting to rear the nymphs in small jars. Whether on account of lack of sufficient oxygen or of appropriate food, or too high a temperature or some other unknown cause, the greater number of nymphs perished as soon as hatched.

The remnant were transferred to a large aquarium used for breeding mussels. This was a zinc-lined tank about two feet deep and with a superficial area of thirty or thirty-five square feet, with a layer of soft mud in the bottom and an overflow arrangement by means of which a quiet but constant stream of fresh water was kept circulating through the tank. There were a number of mussels in the mud and several crayfish. A few water weeds supplied shelter for smaller organisms, of which a large Ostracod was the most plentiful. I observed several of the older nymphs feeding on the Ostracods, and it is possible that the absence of some similar food caused the individuals in the separate jars to die.

The newly-hatched nymphs are very active and, as a rule, keep close to the bottom. They are negatively phototropic until the fourth or fifth instar and this condition, which keeps them in the shadows, aided by their great transparency, is doubtless of much value in enabling them to escape their enemies. The bulk of the eggs hatched July 8. The first moult (second instar) occurred about July 16th, the second about July 24th, the third, July 31-Aug. 3, the fourth, August 10th, and the imagos appeared about August 18th. From the third instar on, the mortality was high. In the morning, numbers would be found on the surface of the water near the edge held by a bubble of air, the buoyancy of which they were unable to overcome and, unless assisted, they perished in this way. It seems probable that they are most active at night as they were rarely seen to dart to the surface frequently, except on dull, dark days.

The Egg.

Length about 9 mm. Breadth about 4 mm. Shape elongate-oval, bilaterally rather than axially symmetrical, i.e., one side nearly straight, the opposite strongly curved. (See Fig. 1.) Colour grayish yellow (later stages only were observed); the surface ornamented with a delicate tracery in the form of interlocking hexagons like a honeycomb or the facets of a compound eye. The egg is fastened in a sort of shallow cup which is of a leathery texture and dark brown in colour. The distal end through which the nymph emerges,
is provided with six to eight short lobes arranged in a circle. The appearance of the whole egg is much like that of a minute Grantia sponge.

Dufour described the eggs of *striata* and *hieroglyphica* as acuminate at the free end and placed on a pad. White speaks of the eggs he describes as pyriform and attached at the broader end. He does not mention the pad or cup, nor does Heidemann, of *Corixa mercenaria*. It would be of interest to discover if there is a difference in this regard between different species of Corixids or whether in some cases the pad or cup has merely escaped observation.

First Instar.

Length about 1.15 mm. Width about .55 mm. General appearance of adult, but wider in proportion to length. (Fig. 2.) Head about three times as wide as long (dorsal aspect); distance from vertex to tip of beak about equal to the width between eyes (ventral aspect). Eyes prominent and conspicuous, deeply pigmented, facets relatively large. The beak is apparently four-jointed, rather broad and conical. The black tips of the mandibles and maxillae project slightly between the two halves. The former are somewhat shorter than the latter, curved, with minute serrations at the tips, and may be seen to extend into the head apparently up to the level of the eyes.

The antennae are two-jointed, inserted far down toward the beak, the last joint about \( \frac{1}{2} \) the interorbital width in length. Tarsi all one-jointed. Those of first leg when at rest, curved over beak as in imago. First tarsi triangular in section, about \( \frac{1}{2} \) as long as those of third leg, \( \frac{3}{2} \) times as long as broad, oblong-triangular, broadly rounded above, the comb of bristles prominent. (Fig. 2a.) Tibia of second leg \( \frac{3}{5} \) the length of tarsus and squarish in section with the anterior angles armed each with a row of short bristles. Intermediate tarsus nearly 8 times as long as broad, with a ventral row of long bristles and several rows of much shorter ones; tarsal claws weak, variable in length. Third leg sparsely bristled, tarsal joint slightly longer than the tibia or the femur, which are subequal. Body a little less than twice as long as broad, the posterior angles not so truncate as in later instars, provided and armed each with a half dozen rather long bristles. Lateral margin of body with bristles on posterior half only.

The tracheal system is comparatively simple, consisting of two longitudinal trunks sending off laterals in each abdominal segment and one stout branch to each leg. Anterior branches supply the brain and the eyes.

Second Instar.

A marked increase in size is noticeable, the length being now about 1.9 mm. and the width about .9, roughly one-half as much. Head strongly convex, the frontal margin with a row of rather long bristles, longest in the middle, shorter toward the eyes. Posterior border deeply sinuate or arcuate.

Prothorax about as long as mesothorax, the two together a trifle longer than metathorax; the contour of the two together forming a narrow oval. Posterior margin of metathorax straight, anterior margin concave; its median length about equal to that of head. Abdomen truncate, seven-jointed, last joint about ½ as wide as first joint, terminated by two groups of rather long setae at the angles.

Tarsi all one-jointed. First tarsus fringed with moderately long setae, about equal to tibia in length. Second legs; tarsus equal to tibia, both together about as long as femur. Third legs with femora but slightly flattened, tarsus nearly as long as femur and tibia together, clothed with setae, these longest at the joint, becoming much shorter distally. Colour very transparent. A median grayish line on thorax.

Third Instar. (Fig. 3.)

Length 2 mm. Width 1 mm. Head as before. Eyes a little more than 1/5 the head-width in width. The wing-pads first appear; about 3/5 the length of thorax, sparsely hairy. Thorax ½ as long as wide. Abdomen as before, fringed on the sides by rather long setae, the posterior angles with conspicuous tufts. Ventral surface sparsely pilose.

Tarsi all one-jointed. The whole first leg about equal in length to the femur of second leg. Tarsus about three times as long as broad, terminated by a sharp spine. Second legs slender; tarsal claws as long as tarsus, other joints as in third leg, all feebly setose. Third legs; tarsus 1½ times the tibia, the latter equal to femur. Tibia and femur together about equal to femur of second leg. Abdomen strongly truncate.

Fourth Instar.

Length 3 mm. Width 1.2 mm. Very much more pigmented and less transparent than previous instars. Posterior margin of
head, posterior angles of eyes, and posterior margin of thorax fuscous. Anterior margin of thorax and inner edge of wing pads with rather dense brownish-black hairs. These together with the pigmented posterior margin of the thorax form a square; a median patch of brown hair joining the band on the anterior margin. General surface of thorax smoky brown with narrow median clear line, and a paler transverse band in the middle. Head pale brown with a darker shading on vertex. Whole dorsal surface of thorax and abdomen sparsely hairy, the abdominal segments faintly indicated by transverse brown stripes. A median longitudinal white stripe \( \frac{1}{3} \) the body-width in diameter runs the length of the dorsal surface of the abdomen. Within this is a series of large pale brown blotches, one on each segment, the third and fourth of these with a distinct crescent of chestnut brown, marginal third of abdomen smoky, fringed with cilia, but these less conspicuous because of the general hairiness of the body. The wing-pads hardly extend beyond the thorax.

Tarsi all one-jointed. **First legs** as before. **Second leg** with femur as long as width of head, equal to tibia and tarsus together. Claws \( \frac{1}{5} \) longer than tarsus. **Third leg** with tarsus equal to width of head, feathered with dense hairs. **Antennæ** \( \frac{1}{2} \) the length of tarsus of first leg. Interorbital space \( \frac{2}{3} \) the width of head, and equal to \( \frac{3}{4} \) the length from vertex to tip of beak.

**Fifth Instar.** (Fig. 4).

Length 3.8 mm. Width 1.4 mm. Dorsal marking as in previous instar, but more intensified. The two median dark brown marks of third and fourth abdominal terga oblong surrounded by a larger oblong of smoky brown. Hairy covering of wing-pads and thorax conspicuous, the median patch of the anterior border extending more

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8. These conspicuous markings are found on the dorsal surface of older nymphs of all species of Corixids that I have examined. I have considered them of glandular nature, and they are so considered by Kunckel d'Herculais (Comptes Rendus, cxx, p. 1,002, 1895), who remarks that the dorsal position of the "scent glands" differentiates the Corixids from Nepa and Notonecta, and put them phylogenetically nearer the Cimicids. J. Gulde, however, in an elaborate monograph published later ("Die Dorsaldrüsen der Larven der Hemiptera Heteroptera" Ber. Senckenb. Ges., 1902, p. 85–136), describes the dorsal glands in all the various families of Rhynochota, including the aquatic families, and denies the presence of such glands in any waterbugs. The Corixids examined were Corixa Geoffroyi (Leach), Arctocorisa linnet (Fieb.) and Cymatia coleoptrata (L.). He claims that the conspicuous markings are merely the site of the insertion of certain abdominal muscles. It would seem worth while to investigate the matter further.
than \( \frac{1}{2} \) the length of thorax down the median axis. Wing-pads extend half way to third abdominal segment. Beak brownish, with short pubescence. Legs pure white, antennæ no larger than before, but fringed with short cilia. Tarsi of first two legs one-jointed; those of third leg two-jointed, otherwise legs as before.

In comparing the various larval stages one is struck by marked increase in the size of the eyes relative to the size of the head as development proceeds. Another point is of great theoretical interest. As is well known, there exists throughout the group an extraordinary sexual dimorphism, such that the uninitiated might be led to class males and females of the same species in different families, so great is the dissimilarity in structure. It is of interest to note that the larval stages up to the last instar, with respect to those structures (palæ, frontal fovea, asymmetry of abdominal segments, etc.), that exhibit this dimorphism, are entirely of the female type. The writer has dissected the much larger Arctocorisa harrisi Uhl. during the last moults, and has found the same thing to be true. A specimen in the fifth instar just ready to moult may easily be "shelled out" of its cuticle and, if a male, the irregular arrangement of the abdominal segments will be found fully developed, but entirely concealed by the regular and symmetrical arrangement, characteristic of the females and larvæ.

**Description of the Imago.**

*Ramphocorixa balanodis*, n. gen. et sp.

**Colour.**—Head yellowish, tegmina pale silvery grayish, almost iridescent in the female, darker in the male, the characteristic vermiculate or banded markings usual in the group nearly obsolete. Pronotum grayish or smoky brown, suffused with darker in the male. Rostrum pale yellowish. Tergum, legs and whole ventral surface of female pure white. Dorsum of male black, except the lateral margins, which are pale, the ventral surface white, except for two broad almost black oblong bands on either side, each nearly \( \frac{1}{2} \) the body-width in width, parallel to but not quite reaching the lateral margin and extending over sternites 3, 4 and 5. Genital segments pale in both sexes. A tiny reddish spot on the outer surface of posterior coxae, next the distal joint. The hairs of the limbs tinged with yellow. Anterior and posterior margins of pronotum fuscous, the former line sinuate. Surface of pronotum otherwise with three complete pale brown lines, little, if at all, arched, and two shorter ones alternating. Clavus nearly transparent, margined with brown, about one-third

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its area adjacent to the scutellum, immaculate. A few complete markings beyond the middle. Corial lines pale smoky or grayish brown, confusedly interrupted or obsolescent, fusing to form three delicate vermiculated longitudinal stripes, these continue upon the membrane. Corium clothed with sparse, fine depressed whitish hairs.

Pronotum and anterior half of clavus rastrate. The tegmina are semi-hyaline, the colour of the dorsum showing through, on account of which the male appears darker than the female. Pronotum lenticular, 2½ times as wide as long, its posterior margin evenly rounded and not produced, a small area of scutellum visible between it and the clavus. Head emarginate behind, the lateral angles (with the eyes) acute and slightly produced. Interorbital space about equal to posterior width of eye. Posterior margin of eye touching occipital margin, except for a short distance at the inner angle. Two parallel rows of punctures on either side of the vertex. Intermediate tarsi ½ the length of tibia, the latter 3/5 the length of femur. Posterior femora and tibia subequal, a little more than ½ the tarsi in length. Metaxyphus small, short, triangular.

Sexual characters.—Male: Head acuminate, strongly carinate, about ½ longer than pronotum. Fovea acorn-shaped, broad and deep, occupying the entire space between the eyes and reaching from the labrum to the acute termination of the carina mentioned. Foveal surface clothed with fine depressed whitish hairs. Palæ shiny ivory-white, very irregular in shape. (cf. Fig. 6.) Lower edge entire, slightly concave; upper surface flat, deeply incised about midway the length, so as almost to cut the pala into two joints. Viewed from the inner surface the outline suggests somewhat the head of a bird of prey. Inner surface with a row of 23 dark brown “pegs”; the first nine following the curve of the upper margin, then the line arching downward to the limit of the cleft. Tip of pala with a single long, serrated spur, a row of short spines along the lower inner edge, a row of longer ones along lower outer edge. The posterior upper margin of the pala projects slightly over the tibia in a flattened spur. Tibia a little less than half the pala in length. Femur with a large stridular area composed of fine spines set in rows. Asymmetry dextral. Strigil very minute, .05 mm. long and 1/5 as wide as long, crescentric in shape, lying in a small membranous projection of the 6th tergite, in the antero-posterior axis, with about 18-20 transverse striæ. Fifth, sixth and seventh tergites divided, fourth deeply cleft.

Female: Venter evenly rounded, front plane with a small circular depressed fovea between the lower inner angles of the eyes. Palæ oblong-cultrate, lower edge straight or slightly incurved, upper edge straight to
the middle, thence truncate to the tip, where there is a short retrorse spine. Tibia same width as palæ and ½ as long.

Length 5 mm.—5½ mm. Boone Co. and St. Louis Co., Mo. July and November.

This species appears to resemble Corixa (Arctocorisa ?) acuminata Uhl., but the structure of the male palæ, which are quite unlike those of any other species in the group, together with the shape of the head in the male, the minute strigil, and the short lenticular pronotum, sharply sets it off from other species. The presence of a frontal fovea in the female is also extraordinary, and together with the points mentioned above seems to warrant separating the species from its congeners in a new genus, for which the name RAMPHOCORIXA is proposed, and of which the following may stand as a diagnosis:

RAMPHOCORIXA, n. gen.—Allied to Arctocorisa Wallen., from which it differs in the form of the male palæ, strigil and shape of head. Differs from Glænocorisa Thoms. in the absence of bristles among the palæ pegs. Pronotum lenticular rastrate. Head of male sharply acuminate, with fovea acorn-shaped, ♀ palæ dorsally, deeply cleft, much longer than tibia, terminated by a long serrated spine; femur with a large stridular area of minute spines. Strigil minute. Fifth, sixth and seventh tergites divided in the male. Asymmetry of male dextral. Female palæ cultrate with a short retrorse terminal spine; face of ♀ foveate.

**Explanation of Plate IV.**

Fig. 1.—Egg of Ramphocorixa balanodis, × 34. The dorsal cup is affixed to the carapace of the crayfish.

Fig. 2.—First instar, ventral aspect, × 82. A = the palæ or first tarsus, × 240.

Fig. 3.—Third instar, dorsal aspect, × 24, showing the beginning of the wing-pads. The setæ of the legs and body are omitted.

Fig. 4.—Fifth instar, dorsal aspect, × 10. The wing-pads have grown beyond the thorax and are covered with downy hair. Cilia of abdomen and legs omitted.

Fig. 5.—Frontal aspect, head of male, × 20.

Fig. 6.—Pala of male, × 51, viewed from inner upper angle. F = femur; T = tibia; P = Pala or tarsus; A = row of pegs; B = stridular area; Q = diagrammatic section of pala marked X.

Fig. 7.—Pala of female, × 68.

Fig. 8.—Antenna × 68.