

NEW GENERA AND SPECIES OF NORTH AMERICAN HYDRACHNIDAE.

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WITH PLATES IX-XII.

In collections made in different parts of Michigan in 1893, 1894 and 1895, were included a considerable number of specimens believed at the time to be not referable to any recognized genera. However, lack of literature made it then impossible to verify this supposition and since under these circumstances the writer was unwilling to assume the responsibility of erecting new genera to receive them, they were laid aside. Now he has at his command references to all genera hitherto described and it becomes possible to characterize with safety those which have not in the meantime been made known by others, for during the time which has elapsed the following genera, to which must be assigned a part of the specimens referred to, have been proposed:

- Tyrrellia* Koenike. (Koenike, 95b: 198.)
- Krendowskia* Piersig. (Piersig, 95a: 147.)
- Limnesiopsis* Piersig. (Piersig, 96: 20.)
- Torrenticola* Piersig. (Piersig, 97d: 155.)
- Albia* Thon. (Thon, 99: 100.)

Aside from these here enumerated, there remain three genera apparently still unnamed, and with these and also with one of those in the list above it is proposed in this paper to deal.

The technical expressions occurring in the paper are applied in the same manner and with the same meaning as indicated in a previous paper by the writer (Wolcott, 99:204) and need no explanation, except perhaps as to the mouth-parts, to the differ-

ent structures of which different authors have applied very different names. The whole irregularly conical mass formed by the mandibles and maxillae and the structures inclosed by them is termed the "snout" and in *Krendowskia*, where unusually protrusible, the "proboscis." The word "rostrum" is applied to the smaller cone at the apex of the snout, made up of the anterior portion of the maxillae, grooved for the passage of the mandibles, and leading to the oral opening at the anterior end. The "maxillary plate" or "maxillary shield" is the plate which forms the ventral surface of the snout, is generally more or less regularly shield-shaped, and fits in between the two anterior epimera. The rostrum appears from beneath as a median anterior projection of this plate.

The divisions of the family Hydrachnidae as recognized by Piersig and used in his great work on German Hydrachnidae (Piersig, 97), are accepted by the writer.

KRENDOWSKIA (Piersig).

Krendowskia Piersig, 95a: 147.

Geayia Thor, 97b: 11.

Diagnosis of genus: An hydrachnid of the sub-family Hygrobatinae, with broadly oval body covered throughout with a thick chitinous exoskeleton containing large goblet-shaped pores, and divided into a larger ventral and a smaller dorsal portion by a continuous suture; with epimera forming four masses; with stout chelate palpi and mouth-parts borne at the end of a protrusible proboscis; with legs bearing swimming-hairs; and with the large genital opening situated between the two posterior epimera and flanked on either side by a large valve which bears on its face three or four acetabula and along its margin a row of minute hairs.

The genus is most closely related to *Arrenurus*, which it resembles in the character of its chitinous exoskeleton, in the form of its palpi, in the arrangement of its epimera, and in the possession of swimming-hairs. It is, however, at once recognized by the character of the genital area, which reminds one

of *Mideopsis*, and by the protrusible proboscis which is quite unique among these mites. The males also possess none of the modifications of form and structure characteristic of the males of *Arrenurus*.

This genus was unknown until, in 1885, Krendowsky described and figured as the female of *Arrenurus punctator* Koch, a mite which Piersig recognized as belonging to a new genus and species and to which he gave the name *Krendowskia latissima*. However, the proposed name was not accompanied by any characterization of the genus or description of the species and, though glad to accept the name, which is a well-deserved recognition of the work of the only prominent Russian student of this group, the author cannot refrain from expressing his dislike of the manner in which the genus was proposed. He would not thus venture to criticize one whose recent magnificent work has made him a recognized authority on the group, did he not feel that the bestowal of generic names in the way indicated was based on a principle radically wrong. It should be required of every author of a genus that in the place where it is proposed he give such a generic diagnosis as will clearly define its essential characters, if no more. Especially is the lack of such a diagnosis to be regretted when the original reference is difficult of access or of use by the majority of students.

The genus *Geayia*, proposed by Thor to include *Geayia Venezuelae*, a species collected in Venezuela by a traveller, M. Geay, seems undoubtedly identical with *Krendowskia*, which antedates it by two years.

An approximate translation of Krendowsky's original description (Krendowsky, 85: 116) is as follows:

"6. *Arrenurus punctator* Koch (Tab. VII, Fig. 11).

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Female—Body oval, convex dorsally, narrower anteriorly, but not excavated in front, and of a pale green color with dark dorsal patches. Chitinous layer of the cuticula containing tortuous pores which anastomose at their inner ends and open externally into cup-shaped depressions. Epimera green; forming

four groups, and in shape differing from those of the different species of *Arrenurus* in the fact that they have rounded outer margins, and do not end in sharp points. The fourth pair has also a marked peculiarity, being produced posteriorly, this posterior portion quadrate in form with rounded corners. Between these two epimera is placed the large genital area which is approximately circular in form. The large round genital opening is closed by two semi-lunar genital plates with wavy outer margins. Along the margin of each plate are placed three narrow elliptical acetabula. Legs of medium length and green in color.

The form is very rare. Only one example was found, August 5th, in the Psel, near the village of Manuilowka, county of Kremenchuk, province of Poltawa.

Male unknown to me."

Thor (97b: 11) describes *Geayia* thus:

"*Geayia*, nov. gen.

Le corps et les pattes, dans ce nouveau genre, sont tout à fait semblables à ceux de *Arrenurus* Dugès. La peau est très dure, avec beaucoup de pores et une ligne dorsale. Les pattes sont courtes et minces, pourvues de soies natatoires.

L'appareil génital, au contraire, rappelle celui de *Mideopsis*, Neum.; il est elliptique et situé entre les épimères de la quatrième paire. De chaque côté de la frente génitale se trouvent quatre ventouses ou pores oblongues, insérées sur les deux valves semilunaires. On trouve quelques pores (fig. 2) très petits disposés en cercle dans la peau, en dehors des valves.

Le plus caractéristique pour *Geayia* est un *rostre énormément long*, paraissant formé de deux articles et d'une forme tout à fait inconnue chez les Hydrachnides adultes.

Il rappelle un peu celui de *Nautarachna* Moniez, moins celui de *Hydryphantes* Koch, *Hydrachna* Müller, etc. Les deux courts palpes sont, fait remarquable, attachés à son extrémité.

Le rostre provient d'un court tube de la peau (tube labial) il forme en dehors du tube deux articles à peu près de même longueur, le second s'élevant à l'extrémité proéminente et un

peu recourbée du premier. Dans le second sont les courtes mandibules, et d'une échancrure du côté supérieur s'élèvent les deux courts palpes formant comme une pince avec le bord inférieur proéminent du rostre.

Chaque palpe a les cinq articles, le premier se cachant, le cinquième ressemblant à un petit crochet, semblable à celui d'*Arrenurus*, et s'articulant avec une protubérance plate du quatrième."

Comparison of the one male specimen in the possession of the writer with Krendowsky's figure and description leaves little room to doubt that that author had a male specimen, which he assumed was a female because of the lack of the usual characters which distinguish the males of *Arrenurus*; while the three female specimens examined belong to the same genus as those described by Thor, and to a species at least closely allied. Krendowsky failed to note the protrusible proboscis, but in the brief examination to which the mites under observation were subjected by the writer, when collected and before being put into the preserving fluid, no such peculiarity was noted in either sex, and it is probable that in the case of Krendowsky's specimen the methods used were such as failed to demonstrate it. Krendowsky's specimen had three pairs of acetabula, Thor's examples four, but this is apparently a sexual character.

It may be simply a matter of individual opinion, but to the writer the dedication of a genus to one neither a student of the group to which it belongs nor prominent for his contributions to the literature of the science of zoology in general seems quite inappropriate.

Krendowskia is a genus of wide distribution, as is shown by its occurrence in localities as widely separated as Russia, Venezuela, and Michigan.

Krendowskia ovata nov. sp.

General form (Pl. IX, Fig. 1) broadly oval, the length exceeding the maximum breadth by but about one-tenth, with the more pointed end directed anteriorly, uniformly rounded at both ends, strongly convex dorsally, moderately convex ven-

trally, and with the dorso-ventral diameter of the body equalling nearly three-fourths of the total length.

Surface of the body covered with a chitinous exoskeleton containing pores placed vertically to the surface. These pores (Pl. IX, Fig. 2) are large, usually more or less irregular in diameter and in direction, are similar to those figured by Norden-skiöld (98: Pl. I, Fig. 3a) for *Arrenurus pustulator*, and give to the body the appearance of being coarsely pitted. The cuticula which covers this chitinous exoskeleton is marked everywhere by irregular fine wavy lines. The furrow which separates the smaller dorsal and the larger ventral portions of the exoskeleton includes an elliptical area, which is, in a male specimen 1 mm. long, 0.835 mm. by 0.651 mm., and which approaches nearer the posterior than the anterior end of the body. Here and there on the dorsal surface (Pl. IX, Figs. 1 and 3) are seen rounded papillae bearing slender hairs.

Eyes rather close together, large, and separated by a distance equal to one-fifth the length of the body.

Proboscis protrusible to a distance equal to 65 per cent. of the body length (Pl. IX, Fig. 3) and divisible into two portions. The posterior of these is soft, capable of being inverted, equal to three-fifths the length of the whole, and thickest proximally while narrowest at its distal end. The anterior, consisting of the mouth-parts, is covered by the chitinous maxillae, is thickest distally, where its breadth is equal to two-thirds the greatest breadth of the posterior portion, and narrowest at its junction with the posterior portion. The anterior ventral angle is produced forming a rostrum the tip of which is even with the end of the palpi and which near its tip bears two small hairs.

Mandibles (Pl. IX, Figs. 4 and 5) long, irregular and ending in a double claw. On the inner side is what appears to be an articular suture but which is not apparent on the outer side.

Palpi (Pl. IX, Fig. 6) relatively small and stout, the average thickness being equal to more than one-quarter of the total length, and chelate like those of *Arrenurus*. Segments 1 to 4 nearly the same in dorso-ventral diameter and 1 and 2 together

equalling the combined length of 3 and 4. Segment 1 is long and forms a ring of uniform width; 2 is the longest and possesses a long convex dorsal margin and a short concave ventral margin, the difference in length of the two causing the two ends to lie nearly at a right angle to one another. The latter possesses two long slender hairs, one on the dorsal margin and another on the inner surface and near the second a third short hair. Segment 3 is comparatively short with the dorsal and ventral margins nearly equal, and bears a hair on the inner surface toward the dorsal margin; while 4 is nearly as long as 2, is thick, and is, toward the tip and on the ventral side, expanded and also produced to a considerable degree. This expanded portion bears a slender hair and another is situated at the distal end of the dorsal margin. The distal segment is short and stout, bears a peg-like spine at the tip, and is opposable with the produced ventral expansion of 4, giving to the palpus its chelate character.

The epimera (Pl. IX, Fig. 7) occupy somewhat more than the anterior half of the ventral surface and are divisible into four groups. Epimera I and II of each side are approximated and also united across the median line, while III and IV of each side are also approximated but separated from those of the opposite side and from I and II of the same side by a considerable interval. The outline of the individual epimera is shown in Pl. IX, Fig. 7. There is little difference in size between I, II and III and all are roughly triangular; while IV is much larger and characteristic in form. The latter meets III by an anterior margin equal to two-thirds the length of the posterior margin of III; the inner margin is excavated anteriorly and is then continuous with the rounded posterior margin which in turn merges into the outer margin so that the epimeron becomes quite evenly rounded posteriorly. The outer margin of the same epimeron is produced antero-laterally and at this point leg IV is attached. Epimera III bears a long slender hair towards its inner end and opening in the excavation in the inner margin of IV is what is apparently a large gland, while toward the median line from this are two long slender hairs.

Legs rather short, only the last pair exceeding the body in length, and the first only two-thirds the length of the body. Legs II and III nearly the same length, though III is slightly the longer. On the whole the legs are rather slender and the segments decrease uniformly in length from the outer end to the base except that in leg III, 5 exceeds 6 and in IV both 5 and 4 exceed 6, 5 being longer than 4. Legs I and II bear numerous long slender spines and hairs; III possesses a cluster of slender hairs on 4 and 5, and one or two serrate spines on 2 and a clump of slender hairs at the distal end of each of segments 3, 4 and 5. There are also at the tip of each of these three segments a few very prominent serrate spines; and 4, 5 and 6 are also characterized by a row of spines on the flexor surface. The claws are retractile, evenly curved, sharply pointed, and possess an accessory claw on the convex margin close to the tip.

The genital area (Pl. IX, Fig. 7) is included for somewhat over one-half its length between the two posterior epimera and is nearly as broad as long, while its length equals about three-tenths the total length of the body. The opening is guarded by two valves each of which bears on its face next the margin elliptical acetabula, in the male three in number, in the female four. Along its thickened margin is also seen a row of about a dozen small spines. How complete the possibility of closure of these valves may be is not apparent from the specimens.

MEASUREMENTS OF A FEMALE SPECIMEN:

Length of body.....	0.924 mm.
Length of palpus.....	0.148 mm.
Length of mandible.....	0.265 mm.
Length of leg I.....	0.612 mm.
Length of leg II.....	0.780 mm.
Length of leg III.....	0.826 mm.
Length of leg IV.....	0.964 mm.
Length of genital area.....	0.281 mm.

The male and female differ but slightly from one another, the most prominent sexual character being the difference in the number of genital acetabula.

Types retained in the author's collection.

Three specimens were collected in Power's Lake, Grand Rapids, Michigan, August 9, 1895, and one in Crooked Lake, Grand Rapids, Michigan, August 19, 1895. The color of the three former specimens as given in field notes taken at the time was "dark rich brown dotted with blackish, legs dull greenish," while the specimen from Crooked Lake is noted as being "dark blue green."

The indefiniteness in regard to certain details in the description of both Krendowsky and Thor makes it impossible to decide with certainty whether or not this species is identical with that obtained by either one of the other two writers. However, the form of the posterior epimera, as well as the general form of body given in Krendowsky's figure, is not quite the same as in the American specimens, the body being proportionately broader while the epimera referred to do not stop short of the inner end of the pair in front, but are prolonged toward the median line to a point even with the inner ends of this pair and this prolongation is at its end even wider than the inner end of the third pair. In Thor's examples the palpi are relatively smaller, while in his description he also says "*La ligne dorsale est presque circulaire ou ovale*," whereas in the writer's specimens the area enclosed by this line is elliptical. In Thor's figure (Fig. 4) this area is a very pointed oval.

On the whole we prefer to describe our specimens as belonging to a distinct species believing that these differences, together with the wide separation of Michigan from the localities in which the others were found, render it probable that such is the case.

The significance of the specific name is at once apparent from the outline of the body.

XYSTONOTUS nov. gen.

Diagnosis of genus: An hydrachnid of the sub-family Hygrobatinae; with elliptical body flattened dorso-ventrally, covered by a chitinous exoskeleton which is separated into smaller dorsal and larger ventral portions by a continuous furrow and is

pierced by numerous fine canals which pursue an irregular course and tend to branch and anastomose; with epimera all fused to form a single plate; with legs without swimming-hairs; and with a genital area large and pyriform and the opening guarded by two valves, on the inner surface of which are three pairs of acetabula.

This genus is, in the character of the genital area and in the possession of three pairs of acetabula, and also in the general form of the body related to *Mideopsis*, but differs in the lack of swimming-hairs and in the relatively longer palpi and in the form of the epimera. The claws are similar to those figured by Piersig for *Midea* in having a sharply pointed and longer tip on the convex side and on the concave a shorter tip slightly curved and spatulate in form. However, the genus differs more widely from *Midea* than from *Mideopsis* in the character of the palpi, of the genital area, of the epimera, and also in the lack of swimming-hairs.

The generic name is derived from the Greek words *xystos*, smoothed as with a plane, and *notos*, the dorsum or back, and is bestowed in allusion to the very characteristic form of the single species here described as belonging to the genus.

Xystonotus asper nov. sp.

Body (Pl. X, Fig. 8) of medium size and with a width about equal to five-sixths the length, elliptical, evenly rounded posteriorly and somewhat flattened but hardly excavated at the anterior end; compressed dorso-ventrally and more convex below than above, the dorsal surface being nearly plane with but a slight antero-posterior convexity, and meeting the lateral body wall at about a right angle. The body is furnished with a few short spines, with two longer ones at the anterior end between the eyes, and with a bunch of three still longer, on either side of the posterior end of the body. The chitinous exoskeleton is very thick, covered by a thin cuticula showing here and there fine irregular lines, and is perforated by numerous branching canals (Pl. X, Fig. 9) which tend to anastomose and which give almost a dendritic appearance.

Eyes rather wide apart, separated by a distance equal to about three-tenths of the total length of the body and of moderate size.

Maxillary shield rather narrow, with nearly parallel sides, a rounded posterior margin, and an acute though not very prominent rostrum.

Mandibles (Pl. X, Fig. 10) rather small, their total length being between one-fifth and one-sixth the length of the body, moderately stout, irregular, and bearing a very large, tapering and pointed claw.

Palpi (Pl. X, Fig. 11) irregular in general form, with segment 2 widest, and the succeeding ones tapering from 3 to 5. The length of the palpus is equal to one-fourth the length of the body and its maximum thickness to two-sevenths of its total length. The first segment is very slender and possesses a spine on the dorsal margin, while segment 2 is much thicker than 1 and thickest of all, is quadrate in form, and bears three stout spines along the dorsal margin, two posterior ones side by side and a third distad of them. Segment 3 is rather short, bears a spine toward the distal end and another at the dorsal margin; 4 tapers from base to tip, has a slightly convex and somewhat irregular dorsal margin and a ventral margin produced in its proximal portion into a beak-like process the tip of which is directed inward with respect to the palpus, bears two small spines and ends in a sharp, somewhat recurved, point. The distal segment tapers gradually from base to tip where it is blunt and terminated by three points.

The epimera (Pl. X, Fig. 12) are united forming one plate which however shows clearly the lines of separation between the separate epimera. Of these epimera I and II are long, narrow, and roughly triangular; III is long and quadrilateral in form; IV again roughly triangular with the three margins nearly equal and with the inner angle rounded. The posterior margin of this fourth pair is not clearly defined but passes over into the surface of the body. The epimeral plate is pierced by pores similar to those which open over the surface of the body,

and upon focussing these pores are seen to lead to branched canals passing through the epimeral plate. Glands open between the first and second and second and third epimera.

The legs (Pl. X, Fig. 12) are rather short and stout, none of them possessing swimming-hairs but all short, stout spines, and all have the individual segments produced distally and the last segment expanded at the tip. The outer margin of each segment is also more or less dentate, this peculiarity being more pronounced in the hind leg than in the fore leg, while in the hind leg the spines tend to group themselves about the tips of the segments. The fourth pair of legs also possesses on segments 5 and 6 a row of spines along the flexor margin. Of the individual legs the first is the shortest and less than four-sevenths the length of the body; II is nearly two-thirds as long as the body; III about four-fifths its length. while IV exceeds it by one-eighth. The length of the individual segments is in each leg, in order, beginning with the shortest, 1, 2, 3, 4, 5, 6. 1, 2, 3, and 4 are nearly equal in I and II, 3 is shortened and only equals 1 in III, and 4 is longer than the other two in IV.

The claws (Pl. X, Fig. 14) possess two tips, a slender strongly curved and sharply pointed dorsal tip and ventrad of this a shorter tip which is but slightly curved and flat and spatulate in form.

Genital area (Pl. X, Fig. 12) situated toward the posterior end of the body and pyriform, while owing to the fact that the genital cleft is shorter than the extreme length of either of the two plates which bound it there is a narrow indentation anteriorly in the median line. The total breadth is even greater than the length. In addition to these two plates set immovably into the wall of the body there are two valves, narrower than the plates, each of which bears near the margin of its inner face three long narrow acetabula in a row one behind the other. Between the genital area and the fourth epimeron of either side is the large opening of a gland.

The anal opening is situated midway between the genital opening and the posterior extremity of the body.

MEASUREMENTS:

Length of body, female.....	0.610 mm.
Width of body, female.....	0.493 mm.
Palpus, total length.....	0.148 mm.
Mandible, total length.....	0.112 mm.
Leg I, (exclusive of claw).....	0.337 mm.
Leg II, " " "	0.393 mm.
Leg III, " " "	0.490 mm.
Leg IV, " " "	0.678 mm.
Length of genital cleft.....	0.127 mm.
Extreme breadth of genital area.....	0.143 mm.

Of this species only two specimens were obtained, from Lake Saint Clair during August, 1893. Both are apparently females, from the fact that an egg is seen within the body of one, and no males have come under the writer's observation. The types are preserved in his collection.

The specific name is suggested by the rough appearance of the animal as a whole and the generally irregular outline of the appendages.

KOENIKEA nov. gen.

Diagnosis of genus: An hydrachnid of the sub-family Hygrobatinae with body greatly compressed and even concave on the dorsal surface, covered by a thick chitinous exoskeleton pierced by fine pores parallel to one another and vertical to the surface; with the antero-inferior angles of the maxillae in the female produced to form a long curved rostrum; with the epimera in the male fused forming a single plate, in the female forming a plate on either side; with legs bearing swimming-hairs; and with the genital cleft flanked by two large valves and numerous acetabula imbedded in the wall of the body.

This genus belongs, with the next, among those which in Piersig's arrangement immediately precede *Arrenurus* and which include *Axonopsis* Piersig, *Albia* Thon, *Aturus* Kramer, *Torrenticola* Piersig, *Mideopsis* Neuman, *Midea* Bruzelius, and *Xystonotus* mihi. It is, however, peculiar in the form of the body, in the character of the genital area, and, in the case of the female, in the possession of a long rostrum. This latter

structure, which will be more fully described in connection with the description of the species, is, in the male, similar to that figured by Piersig for *Mideopsis*, but in the female is unlike any structure hitherto described, although *Torrenticola* shows a tendency to the production of the rostrum in a somewhat similar manner. From *Aturus*, *Torrenticola*, and *Xystonotus*, this genus may be at once distinguished by the presence of swimming-hairs; from *Mideopsis*, *Midea*, *Albia*, and *Axonopsis* it is easily distinguished by the character of the epimera and genital area. The author takes great pleasure in dedicating this characteristic and attractive genus to Dr. Ferdinand Koenike of Bremen, Germany, whose name is perhaps the most prominent of all among students of the group owing to the length of time he has devoted to the subject, the number of his writings, and the numerous and valuable additions he has made through them to our knowledge of the subject.

Koenikea concava nov. sp.

Of medium size, the males averaging about 0.62 mm., the females from 0.72 to 0.75 mm. As seen from above (Pl. XI, Fig. 15) nearly circular in outline, being but slightly longer than broad, and with a slight excavation between the eyes which is rendered more apparent by the projection of the latter from the body; viewed from the side, however, the mite is seen to be greatly flattened, convex below, and even concave above. There is a slight antero-posterior convexity but the concavity is more marked and thus is formed a sharp rim extending entirely around the margin. The dorsal portion of the exoskeletal covering is the smaller and the furrow separating it from the ventral forms a nearly circular outline parallel to the margin of body, from which it is separated by a moderate interval. This exoskeleton is pierced by numerous fine pores (Pl. XI, Fig. 16) parallel to one another and vertical to the surface and is covered by a thin structureless cuticula. The body is also marked by more prominent pores, which probably represent the openings of glands, and bears several hairs arising from papillae below and in front of the eyes and two hairs at the posterior margin of the body.

Eyes a moderate distance apart, the interval between them a little less than one-third the length of the body, black and prominent.

The rostrum of the male (Pl. XI, Fig. 17) is moderately prolonged, the lower margin to a greater extent than the upper causing the oral opening to look upward as well as forward. The lower margin of the rostrum of the female (Pl. XI, Fig. 18) is greatly elongated and forms a long upwardly curved spine bearing a dorsal median groove which ends just before the tip. This rostral spine at its base equals in thickness one-fourth the maximum dorso-ventral diameter of the snout, tapers very gradually to a bluntly rounded tip and has a total length, measured along its axis, about equal to the rest of the snout. In the groove on the dorsal side of the rostrum runs the elongated distal segments of the mandibles. This mandibular "claw" are attached to the ventral side of the basal segment of the mandible close to the tip (Pl. XI, Fig. 21), and is remarkably slender while the basal segment is not specially noteworthy, having about the usual form with a concave ventral and convex dorsal margin and a rounded posterior extremity.

Palpi (Pl. XI, Fig. 19) weak in proportion to the size of the body, equalling in the male only three-tenths of the body length, and also unusually slender, having a maximum breadth equal to only one-sixth the total length; even weaker in the female than in the male. Segment 2 the stoutest, yet but little stouter than 1, and those beyond gradually becoming more slender to the tip. Segment 2 bears two spines on the extensor surface and 3 a long slender hair on the extensor surface and another on the inner surface; 4 a slender hair on the outer surface and on the flexor surface nearly at the tip a short papilla tipped by a very small spine. The distal segment bears a small dorsal claw-like spine a little back from the tip, a stouter median spine somewhat further toward the tip, and these, together with the narrowed ventral tip, gives the segment the appearance of ending in three points.

The epimera in the male (Pl. XII, Fig. 23) are united into one plate which is pierced by pores similar to those over the rest of

the surface of the body and in which the limits of the separate epimera are indicated by denser, more highly refractive, broad strips of chitin. In the female (Pl. XII, Fig. 24) the epimera form two masses, one on either side, and a narrower interval separates the two anterior of the opposite sides, while a broad space intervenes between III and IV of the opposite sides. The inner ends of II and III of each side are separate, forming a wide angle. The outline of the whole epimeral area is irregular, with rounded angles, considerably emarginate between the places of attachment of the legs and with a shallow concavity in the median line posteriorly which is limited externally by rounded angles in the middle of the hind margin of epimera IV.

Legs of the male rather short, I only three-fourths of the body length, II nine-tenths as long as the body, III still nearer the length of the body, and IV nearly one-tenth longer. In the female the legs are relatively longer, I being six-sevenths and II over nine-tenths the body length, while III is a little longer than the body, and IV exceeds it by one-fifth. Of individual segments the distal is the longest and the rest decrease in length in order toward the base, except that 2 exceeds 3 in all cases with the exception of leg IV of the female. The legs are rather slender and rather sparingly supplied with slender spines and swimming-hairs, the latter being found on segments III 5, IV 4, and IV 5. At the tip of III 4, there is also a stout serrated spine, and on IV 3 one, and on IV 4 and IV 5 two each (Pl. XI, Fig. 20); the serrated spines in each case are in line, being the most distal of a row of blunt spines on the flexor margin of the segment. In the male the spines are fewer and the legs slenderer than in the female.

In the case of both male and female the genital cleft (Pl. XII, Fig. 24) is long, equaling one-fifth the total length of the body, and is flanked by two large movable chitinous valves which together form a broadly pyriform area of considerable size. On either side outside of these valves and opposite their posterior portion are about twenty small acetabula imbedded in the body wall, while between the anterior portion of these valves and

the posterior epimera are what appear to be the openings of two large glands, and just external to these two long hairs.

The anal opening is situated at the posterior end of the body and on either side of it are two hairs.

MEASUREMENTS:

	Male	Female
Length of body.....	0.618 mm.	0.685 mm.
Breadth of body.....	0.584 mm.	0.618 mm.
Length of leg I.....	0.464 mm.	0.571 mm.
Length of leg II....	0.566 mm.	0.637 mm.
Length of leg III.....	0.597 mm.	0.719 mm.
Length of leg IV.....	0.663 mm.	0.826 mm.
Length of palpus (approximate)...	0.190 mm.	0.210 mm.
Length of genital groove.....	0.122 mm.	0.143 mm.
Extreme breadth of genital valves.	0.117 mm.	0.133 mm.

The types are retained in the author's collection; co-types will be deposited in the collection of the Zoological Department, University of Nebraska, in the Museum of Comparative Zoology of Harvard University, in the United States National Museum, and in the Kgl. Museum für Naturkunde in Berlin.

Numerous specimens of this species were secured in Lake Saint Clair, Michigan, during August and September of 1893; in Susan and "26" Lakes, Northern Michigan, in August, 1894; and in Reed's, Fisk's, Lamberton, Powers', and Dean's Lakes, near Grand Rapids, Michigan, in July and August, 1895. It thus seems to be a common and widely spread species, at least in Michigan.

The name is bestowed in reference to the very characteristic form of the body, the dorsal surface of which is strikingly concave.

TANAOGNATHUS nov. gen.

Diagnosis of genus; An hydrachnid of the sub-family Hygrobatinae, with body compressed dorso-ventrally and covered by a very thin exoskeleton consisting of a network of chitinous trabeculae, and divided into a smaller dorsal and a but slightly larger ventral portion by a continuous suture; with the rostrum of the female(?) produced as in the female of *Koenikea*, and with

the epimera similar to those of that genus; with the distal end of the fourth segment of the palpus bearing a nipple-like process, extended parallel to the distal segment; with the legs bearing a few swimming-hairs; and with the genital cleft short, unguarded by valves or plates of any kind, and with the numerous acetabula imbedded in the wall of the body.

This genus is described from only one specimen, the sex of which it is impossible to determine owing to the manner of preservation, which has not been such as to preserve the internal structure. The marked resemblance of the specimen to the females of *Koenikea* renders it probable that it is a female of a closely allied genus and, at the same time, serves to distinguish it, with *Koenikea*, from all other genera.

The author recognizes the danger of establishing a genus under the circumstances, but is forced either to assign the species to the genus *Koenikea* or to establish a new genus to receive it, and believes that the very marked difference in the character of the chitinous exoskeleton, the characteristic form of the palpi, the absence of any valves or plates guarding the genital cleft, and also the peculiar form of the claw of the first leg, which is quite unique among the forms hitherto described, and which suggests that the specimen may be after all a male, are of sufficient weight to justify the placing of it in a different genus.

The name is derived from the Greek *tanaos*, long, and *gnathos*, a jaw, an allusion to the elongated rostrum, which is a marked peculiarity of this genus, although a peculiarity shared by the genus previously described.

Tanaognathus spinipes nov. sp.

The specimen which is here described is 0.668 mm. in length and almost precisely the same in maximum breadth, the outline of the body being thus circular. It is considerably compressed dorso-ventrally and with a very slightly convex and quite uneven dorsal surface and a more convex ventral surface. The body is covered by a very thin chitinous exoskeleton, the pores of which are so large that it is apparently made up of a fine network of chitinous trabeculae; outside of this is a cuticula marked

by fine, wavy, parallel striae. In front of the eye and external to it is a papilla bearing a small hair, and toward the median line are two more, the one nearest the median line being the larger. A furrow, which is very close to the margin on the dorsal side thus making the ventral portion but slightly the larger, separates the dorsal from the ventral portion of the exoskeleton.

The eyes are large and rather wide apart, the distance between them being 0.284 mm.

The mouth parts (Pl. XII, Fig. 25) bear a very close resemblance to those of *Koenikea concava* and can best be described by a direct comparison with those of that species. The dorsal surface of the snout is less convex, and the ventral is not only less convex but is also almost continuous with the lower surface of the projecting rostrum instead of there being a considerable angle between them. The snout is, therefore, proportionately longer in the species under consideration while, it may be added, the palpi and rostrum are in proportion noticeably shorter. Two long, relatively stout hairs arise from the vertex between the palpi and run downward toward the rostrum, then turning forward are applied to its dorsal surface. As above indicated, the rostrum appears to arise from the anterior end of the snout at the ventral margin, and runs forward curving gradually upward, whereas in *Koenikea* the rostrum appears to come from the middle of the anterior end of the snout and forms a right angle with the surface ventrad of its base.

The palpi (Pl. XI, Fig. 22) are markedly different from those of *Koenikea concava* and very characteristic. On the slide neither one of the two lies in the best position for observation, but it is evident that the palpi are relatively short, that the basal segment is unusually stout, exceeding considerably in breadth any of the rest, and that the rest gradually decrease in thickness to the tip. Owing to foreshortening the exact relative length of the segments cannot be told, but 3 is certainly much longer and 4 much shorter than usual. Segment 2 bears a small hair in the middle of the extensor surface; segment 4

not only receives at its tip segment 5, but internally to the articulation with 5 the segment is produced into a nipple-like papilla projecting parallel to 5 to a distance equal to one-third the length of the distal segment. At the base of this papilla and on the internal surface of the segment is a small hair, while on the inner side of 5 is also a small hair. Segment 5 ends in a blunt tip which shows, in a very inconspicuous manner, the presence of three chitinous claws.

The outlines of the different epimera (Pl. XII, Fig. 26) are distinct but all the epimera meet one another except for a very narrow interval between the anterior pair and an open space at the angle between I, II and III. The outline of the whole epimeral field is similar to that of the male of *Koenikea concava*, but the external margin of IV is more produced and the angle on the posterior margin of the same epimeron is sharper.

The legs are relatively stout, the first unusually long and the last proportionately shorter. The measurements of the legs are as follows: I, 0.704 mm.; II, 0.770 mm.; III, 0.775 mm.; IV, 0.816 mm. The segments in each of the legs are, in order of length, beginning with the longest, 5, 6, 4, 2, 3, 1. In each leg segment 5 is swollen at the middle and possesses a convex extensor margin, while segment 6 is curved toward the tip, the extensor margin being convex, the flexor concave. Of the individual legs, I is the stoutest and its claw (Pl. XII, Fig. 28) is peculiar, being very long, slender, and extending straight out beyond the tip of segment 6 to a distance equal to one-half the length of that segment. There is a stout serrate spine at the tip of segment 5 on the ventral side. Segment II 5 also bears a similar serrate spine and the claw of II 6, like that of the rest of the legs, is small, simple, and evenly curved. Leg III is similar to leg II, while IV is noteworthy. This last leg (Pl. XII, Fig. 27) possesses two serrate spines, one beyond the other on the flexor surface of segment 3, five in a row on 4, and a row of six on 5, while a single long swimming-hair is borne at the tip of 3, two at the tip of 4 and three at the tip of 5.

The genital cleft (Pl. XII, Fig. 26) is very short, being only 0.071 mm. long, and is unguarded by valves or plates of any kind. On either side and occupying a field semicircular in outline with the straight side antero-lateral are about forty-five acetabula imbedded in the wall of the body. On either side just laterad of the posterior end of the genital cleft is a small hair, behind which is a long slender one, and still further posteriad another small one.

Anal opening toward the posterior margin of the body.

The single specimen observed was taken from Soft-water Lake, Grand Rapids, Michigan, August 19, 1895, and in field notes made at the time the color is described as of a bright red with greenish blue legs. This type specimen is retained in the author's collection.

The name is suggested at once by the character of the legs.

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* The designation of each reference must be for the reader an arbitrary one, but is that used by the author in his card catalogue which he feels sure is practically complete for the Hydrachnidae and where it has been carefully chosen to indicate the sequence of publication, and is retained here to secure perfect uniformity in citation in this and other articles contributed by him.

EXPLANATION OF PLATES.

All figures drawn with the aid of a camera lucida.

PLATE IX.

All Figures of *Krendowskia ovata* nov. sp.

- Fig. 1. Dorsal view of body of male. X 60.
Fig. 2. Sketch from an optical cross-section of the exoskeletal covering and cuticula. X 384.
Fig. 3. Side view of a female specimen, showing the general character of the proboscis. X 60.
Fig. 4. Outer side of mandible of female. X 294.
Fig. 5. Inner side of same mandible as in the case of Fig. 4. X 294.
Fig. 6. Inner side of left mandible of female. X 250.
Fig. 7. Epimeral field and genital area of female. X 75.

PLATE X.

All Figures of *Xystonotus asper* nov. sp., female.

- Fig. 8. Dorsal view of body. X 96.
Fig. 9. Sketch from optical cross-section of the exoskeleton and cuticula. X 384.
Fig. 10. Inner side of left mandible. X 440.
Fig. 11. Outer side of right palpus. X 440.
Fig. 12. General view of body from beneath, the mouth parts removed. X 96.
Fig. 13. Ventral view, at a focus which brings out the form of a section of the body at the level of the constriction dorsad of the origin of the legs, the latter arising from the dorsal side of the epimeral plate. X 96.
Fig. 14. Outline of the claw of the right fore leg. X 650.

PLATE XI.

All but Fig. 22, of *Koenikea concava* nov. sp.

- Fig. 15. Dorsal view of body of male. X 86.
Fig. 16. Sketch from optical cross-section of the exoskeleton and cuticula. X 650.
Fig. 17. Snout of male from the side. X 294.
Fig. 18. Side view of snout of female. X 416.
Fig. 19. Inner side of left palpus of male. X 625.
Fig. 20. Anterior surface of left leg IV of female. X 156.
Fig. 21. Outer side of left mandible of female. X 305.
Fig. 22. Inner side of left palpus of *Tanaognathus spinipes* nov. sp. X 440.

PLATE XII.

- Fig. 23. Outline of epimera of female of *Koenikea concava* nov. sp. X 167.
Fig. 24. Epimeral field and genital area of male of *Koenikea concava* nov. sp. X 130.
Fig. 25. Snout of *Tanaognathus spinipes* nov. sp., side view. X 230.
Fig. 26. Epimeral field and genital area of *Tanaognathus spinipes* nov. sp. X 95.
Fig. 27. Anterior surface of left hind leg of *Tanaognathus spinipes* nov. sp. X 187.
Fig. 28. Posterior surface of distal segment and claw of right leg I of *Tanaognathus spinipes* nov. sp. X 130.



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