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BULLETIN

OF THE

ILLINOIS MUSEUM OF NATURAL HISTORY.

NUMBER I.

LIST OF ILLINOIS CRUSTACEA,

WITH DESCRIPTIONS OF NEW SPECIES.

By S. A. FORBES.

The following list is to be regarded as only a first contribution to the knowledge of our crustacea, as it presents the results of a single season's work. Considering the fact that, while our streams and pools are populous with interesting forms, many of which are new, only a single species outside the genus *Cambarus* has heretofore been credited to the state, it is hoped that even so imperfect a paper as this may not be without its uses.

I wish to acknowledge especial obligations to Professors A. E. Verrill and S. I. Smith of Yale College for specimens and for suggestions concerning the species of *Eubranchipus* and *Crangonyx* described herein, and to the latter of these gentlemen for many other favors.

Cambarus acutus, Gir. Very common in central Illinois. Taken in large numbers at Normal and Pekin. Of 25 males examined, the first abdominal legs were all those of Hagen's variety A. In none was the epistoma pointed, and a distinct lateral thoracic spine was present in but one. In twenty of the specimens the margins of the rostrum were distinctly convex from the base to the apical teeth; and the latter were in all much smaller than in Hagen's figures, the distance across the teeth being but one-fourth to one-third that across the base of the rostrum between the tips of the spurs. The tubercle in the basal foveola was elongated, notched in front and continued backward into a very slight cephalo-thoracic carina. Between the posterior callosities and the transverse line, the cephalo-thorax was finely rugulose. The females observed were also variety A.

C. stygius, Bundy. "Male. Rostrum long, triangular, smooth above, small teeth near apex, foveolate at base; carinæ parallel, separated from base of rostrum by slight grooves; cephalo-thorax somewhat compressed, smooth or slightly punctate above, granulate on sides, areola narrow, smooth;

antennal plates wide, truncate at apex, apical teeth short; epistoma rounded in front, twice as wide as long; third maxillipedes hairy on inner sides, hands short, smooth above, serrate on inner margin, fingers short, straight, ribbed and punctate above, contiguous margins tuberculate, outer one hairy; third and fourth joints of third thoracic legs hooked; first abdominal legs short, truncate, enlarged towards apex, apical part recurved, then ending in three obtuse points turning outward, leaving a wide groove passing up on outer side behind teeth. The female has ventral ring flat, with posterior margin slightly elevated. Lake Michigan; washed up during a violent storm." (*W. T. Bundy.*)

C. troglodytes, Lec. This species I have not yet taken. It is mentioned here on the authority of Dr. Hagen.

C. virilis, Hagen. A few specimens have been collected at Normal, Cairo and Pekin, Ills., all young or of the second form except one male from Normal, which belongs to Hagen's variety A. The thorax is, however, broader and smoother, and the areola wider than in the typical form, which has been received from Rock river, Wis.

C. wisconsinensis, Bundy. "Male. Rostrum wide, narrower in front, straight, nearly plane above, foveolate at base, anterior teeth small, acumen short, acute; cephalo-thorax cylindrical, punctate, anterior margin not angulated, lateral tooth obtuse; dorsal area rather narrow, indistinctly defined; antennal plates longer than rostrum, greatest width in apical half; antennae slender, reaching to middle of abdomen; epistoma as wide as long, truncate in front; maxillipedes hairy on inner side and below at base; third joint of third legs hooked; first abdominal legs long, bifid, nearly straight, exterior part longer, tips slightly recurved; tips of interior parts recurved, acute, swollen near apex. Normal, Ill., and Racine, Wis.." (*W. T. Bundy.*)

C. placidus, Hagen. "Quincy, Ill.," (Hagen.) I have not seen this species.

C. propinquus, Gir. Not common. Taken at Normal, Pekin and Freeport.

C. immunis, Hagen. This is the commonest species of central Illinois. It is especially frequent in the muddy ponds of the prairies, whence it may be drawn by the hundred with a small seine.

The general form of the rostrum of the young is the same as that of the adult; but more or less evident ante-apical teeth are present. The abdominal legs of the second form of the male are much thicker at the tip. In the first form the branches are slender and distinct throughout the distal half of their length, the outer branch is compressed at tip, and the inner depressed and widened a little, and channeled on the anterior surface. In the second form both branches are equally thick and strong, neither is compressed or channeled, and the two do not separate except at their tips after making the backward turn. The sudden thickening of the leg at its posterior middle is much less evident in the second form.

About one-fourth or one-half the specimens taken from stagnant ponds in midsummer are more or less completely covered above by the eggs of a species of *Corixa*,—probably *C. alternata, Say*, since this is much the

commoner of the two species found in such situations, the other being as yet undescribed.*

These eggs are attached as closely as they can be placed, by the end opposite the micropyle, and do not seem especially to inconvenience their bearers.

The point of attachment preferred is the margin of the abdomen, out of the way of the legs; but the eggs are gradually extended along the sides of the cephalo-thorax until sometimes the body is almost entirely covered. A careful search of the weeds and other submerged objects in the ponds discovered no other place of deposit of these eggs. As these ponds usually go dry during the summer, it seems not unlikely that the Corixa may attach its eggs to the crawfish in order that the latter may, in such an event, carry them to other waters. It is not to be supposed, however, that the Corixa is entirely dependent on the crawfish for the preservation of its progeny, for the parent can fly, and is occasionally taken on the wing; nevertheless, this curious expedient must prevent a great waste of eggs, and so operate to the advantage of the species. But the subject requires further study.

C. obesus, *Hagen*. Very common. The largest in the state.

C. gracilis, *Bundy*.* "Rostrum short, wide, depressed, concave above, acumen short; cephalo-thorax compressed, areola none, the pleura meeting on median line of dorsum, posterior spatium much wider than anterior; chelae long; inner margin tuberculate-serrate, fingers slender toward apex, outer one with strong tubercle on inner margin near base, movable finger with strong tubercle near middle of inner margin; carpus long, strongly toothed on inner, and lower front margins; third maxillipedes hairy on inner sides; third joint of third thoracic legs hooked; first abdominal legs of male truncate, with several small apical teeth, of which the inner one is much longest, slender and pointed outward, base of these legs inserted in deep sinuses in the strongly developed ventral part of first abdominal segment. Ventral ring of female movable; longitudinal fissure widest behind." (*W. T. Bundy.*) Very common along water courses in early spring. It was first detected by Prof. Bundy, in the museum collections, in the autumn of 1875, has since been taken in great numbers at Normal, and has been received by Prof. Bundy, from Racine, Wis.

Palaemon ohionis, *Smith*. Abundant at Cairo, where it is frequently eaten. Smaller specimens were taken in the Mississippi near Grand Tower, in Jackson county, and it is reported by boatmen to occur from St. Louis to New Orleans, growing larger towards the south. It has not yet been found in the Illinois River.

Palaemonetes exilipes, *Stimp*. Very common in the Illinois River, where it seems to be the only shrimp. Taken in large numbers at Pekin.

Hyalella dentata, *Smith*. Occurs in myriads in the swamps of the Calumet river, at South Chicago, and sparingly in Rock river, at Oregon, Ogle county. Not seen further south.

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*Uhler.

*The descriptions quoted have been kindly furnished me by the discoverer of the species.

Gammarus fasciatus, *Say*. Apparently occurs throughout the state, in small rocky streams. Collected at Deer Park, La Salle county, in a small branch of the Vermilion, and in several streams in Jackson and Union counties. Scores of males and females were taken together under stones, on the 30th of July.

In specimens from southern Illinois, the hands of the first pair in both sexes bear stout spines on the distal half of the posterior margin in addition to those on palm and at the tip of dactyl. A short transverse row of long hairs is situated at the base of the median palmar spine. The inner side of the hand of the second pair in the male is ornamented with two longitudinal series of short transverse rows of hairs,—the posterior of five rows, the anterior of three. The palmar margin in the female has the lamellar edge. The lateral clusters of spines on the fourth posterior abdominal segment, in both sexes, each contain one very stout spine and several slender ones, while the median cluster consists of slender spines only. Each of the clusters on the fifth and sixth segments consists of two stout spines and several slender ones, except the median fascicle of the sixth segment, which consists of two distinct clusters of slender spines. The divisions of the telson have two clusters of hairs on the upper surface near the outer margin, of which the basal contains two spines. The spiny tips of the divisions are emarginate.

Crangonyx gracilis, *Smith*. Very common in central Illinois. Collected at Bloomington, from slow, shallow streams. These specimens differed in several small details from those described by Prof. Smith, the most important relating to the caudal stylets. In the typical form the tips of the three pairs are even; but in the Bloomington specimens the second pair extends farther back than the third, and the first farther than the second. The inner ramus of the last pair is sometimes unarmed, but oftener bears one or two spines at or near the tip. The length of ovigerous females is 10 mm.; of the largest males observed 8½ mm.

A form from southern Illinois represented in my collections by a few females, I cannot distinguish specifically from the above, although the second hands are proportionally longer and narrower and much more spiny, the anterior and posterior margins less convex, and the palmar margin more so. The tips of the caudal stylets reach the same perpendicular plane, and the inner ramus of the last is always as long as the width of the outer and bears one or two spines.

Crangonyx mucronatus, *Forbes*. This remarkable species is perhaps entitled to rank as the type of a new genus; but, until I have the material for a more general study of its relations than I am able to make at present, I prefer to place it with its nearest allies in the genus *Crangonyx*.

Colorless, blind; *length* 9 to 10 mm, *width* 1 mm. The *head* is a little longer than the first thoracic segment, its anterior margin concave at the bases of the upper antennae, convex between them; the posterior margin straight in the middle and curving forward on the sides. The front angles of the first *thoracic segment* are uncovered and produced a little forward; the hind angles of the first five segments are rounded and produced strongly backward. The first three *abdominal segments* have the lateral

margins and all the angles broadly rounded, and the posterior angles, as well as the posterior margin of the seventh epimeron, are slightly notched and bristled. The *upper antennæ* of the male are two-thirds to four-fifths as long as the body. The first and second joints of the pedicel are sub-equal, each about as long as the four basal joints of the flagellum; the third is one-third as long as the second. The flagellum is about five times the length of the pedicel, and is composed of 30 to 35 joints, each with a few short hairs at tip, and all except the seven or eight basal joints and the last with a slender olfactory club. The secondary flagellum contains two bristled joints, together a little longer than the first of the primary flagellum. Pedicel of *lower antennæ* longer than that of upper, the last two joints equal, each a little longer than basal joints of upper antenna. Flagellum nine or ten jointed, without olfactory clubs. Right *mandible* with dental laminae equal, each with five conical, obtuse, sub-equal teeth. The anterior lamina of the left mandible is much the larger and stronger, with three very strong, blunt teeth; posterior lamina with three slender and acute teeth. *Palpus* three-jointed; basal quadrate, about half as long as second, which is clavate and nearly twice as wide as long, with about ten long hairs on its rounded hind margin which are longest and closest distally. Last joint a little longer and narrower than second, regularly convex in front, straight on proximal half of hind margin, slightly concave on distal half, and fringed here with about 24 slender hairs, the three or four at tip becoming suddenly very much longer. A few scattered hairs on front margin of this joint.

Inner plate of anterior *maxilla* is nearly hemispherical, about half as long as outer, with four plumose hairs on the rounded margin, which are about as long as the plate itself. *Palpus* two-jointed, first quadrate, one-third as long as second, which is oval, pointed, tipped with two claws and some smaller spines. Laminae of basal joints of *maxillipeds* short, neither pair extending beyond tips of succeeding joints.

First two pairs of feet equal. Dactyl of first pair in male curved, two-thirds as long as *hand*. The latter is broad-ovate, two-thirds as wide as long, the palmar and posterior margins forming a wide angle. Long hairs on posterior surface in transverse rows. Palm with about fifteen short, notched spines, each with a hair arising from the notch. Carpus sub-triangular, three-fourths as wide as propodus, hind margin very short, with one or two pectinate spines and a few long hairs. Second pair similar, propodus a little longer and narrower; carpus as wide as propodus, posterior margin longer, with about five transverse rows of long bristles, of which the distal row are doubly pectinate on terminal third. The three posterior pairs of *thoracic legs* increase in size backwards, the first of these being not quite two-thirds as long as the last. The seventh epimeron is narrow, with the lower margin regularly arcuate. The tips of the first pair of *anal legs* extend beyond the tips of the second, and these beyond the tips of the third. The latter are therefore very short, about as long as the pedicel of the second pair. The outer ramus is ovate, truncate, half as long as the pedicel, and hairy at tip; the inner is an unarmed rudiment, one-fourth or one-fifth the length of the outer. The *telson* of the male is a smooth cylindrical

appendage, usually about as long as the first three abdominal segments, and as large as the last joint of the pedicel of the lower antenna. It presents a very slight double curve, is obliquely rounded at the end and tipped by a cluster of short hairs. In some cases this appendage is half as long as the body.

The female differs in the following particulars. The upper antennae are only about half the length of the body, the flagellum not more than three times as long as the pedicel, and the secondary flagellum is usually a little shorter. The propodus of the *first pair of feet* is similar in outline, but the palmar margin and dactyl are shorter and the posterior margin longer. The *second pair* are extremely like the second of the male, but are decidedly smaller than the first. The *telson* affords a difference so remarkable that the two sexes, at first sight, would hardly be referred to the same genus. In the female this is very similar to the telson of *C. gracilis, Sm.* It is flattened and slightly emarginate, a little longer than broad, extending to the tips of the second pair of anal legs, and bears two terminal clusters of spines of four or five each.

This species was first discovered by me in a well at Normal, Ill., during the summer of 1875. It was subsequently found by Mr. Harry Garman in great numbers in springs, and even at the mouths of drains, after a long period of heavy rains. With the advent of dry weather it entirely disappeared from these, but still occurs sparingly in wells.

Asellus brevicauda, Forbes. Length without caudal stylets, 10 mm. to 15 mm.; width, 3 mm. to 5 mm. Color as in *A communis.* Head a little longer than first thoracic segment and about two-thirds as wide; anterior margin distinctly concave in middle and retreating each side, anterior angles distinct, sides straight, nearly parallel on anterior three-fourths.

The posterior fourth is produced on each side into a prominent lateral lobe bearing several stout spines. The distance to which this lobe projects equals half the length of the lateral margin of the head in front of it. The *eyes* are rather small but prominent, and are situated just within the middle of the straight portion of the lateral margin. The re-entering angle at the side of the head is a little less than a right angle, but its apex is rounded. The *thoracic segments* are sub-equal in length, of the usual shape, but becoming very concave behind. The concavity of the last segment amounts to more than half the length of the segment. The anterior angles of the first segment are deeply emarginate, the notch being nearly filled by the epimeron; but there are no other lateral emarginations in any of the segments, nor are any other epimera visible from above. In some young specimens the lateral margins of the two or three posterior thoracic segments are slightly sinuate. The hind angles are all rounded, and the free margins are all beset with long bristles, longest on the lateral margins and especially at the angles.

A short first *abdominal segment* is visible in the concavity of the last thoracic. The last abdominal is wider than long, with a broad rounded projection occupying the median half or two-thirds of the posterior margin, reaching half way or more to tips of pedicels of caudal stylets. The pos-

terior lateral angles are distinct though obtuse, the hind margin being somewhat concave each side the median lobe; and the margins are hairy as in the thorax.

The *upper antennae* are nearly as long as the pedicel of the lower. The flagellum consists of 11 to 13 joints, the two terminal together about as long as the preceding one. The three joints preceding the last bear, each at its anterior internal angle, a large olfactory club about at long as the eighth joint of the flagellum.

The *lower antennae* extend backward about to the base of the abdomen. The last joint of the pedicel is as long as the two preceding. The flagellum contains about 60 joints in the female and 90 in the male.

The *palpus of the mandible* is small, three-jointed, the first joint clavate, with three spines on the distal half of the posterior margin and one or two at tip. The second joint is about twice as long as wide, slightly concave in front and with a distinct median angle behind. There are two or three scattered hairs on the basal half of the posterior margin, and many long plumose hairs, shortening distally, on the terminal half. The third joint is ovoid, tapering, very broadly rounded in front and distinctly concave behind. The concave posterior margin bears a row of long plumose hairs, regularly lengthening toward the tip, and a sub-marginal row of shorter hairs on the side of the joint. The basal joint of the *palpus of the maxilliped* is very short, transverse, about thrice as broad as long, with outer margin perpendicular to terminal. The second joint is a little broader than long, rounded slightly without, very broadly within, and plentifully ciliate on both edges.

The third joint is about two-thirds as long as second, broadly and regularly rounded within, narrowed about one-third at tip; the fourth clavate, incurved, as long as second, at tip about half as wide as long; the fifth about half as wide and long as fourth, incurved, obtuse. All the joints bear long marginal hairs.

The *first pair of feet* in the male are strongly sub-chelate; the propodus a little more than two-thirds as wide as long, the palmar margin straight, with one strong tooth at base and another at middle. The posterior margin is only about one-fifth the palmar, and perpendicular to it. The dactyl is strong, curved, serrate behind with about seven distinct teeth. The terminal claw is strong, acute and curved. Both margins of the propodus and the front of the dactyl are hairy: a cluster of longer hairs is seen near base of claw of dactyl.

The propodus of the female is a little narrower and the palmar margin is somewhat concave. The tooth at the middle of the palmar margin is smaller, but quite distinct.

The *basal abdominal plate* beneath in the female is obtusely triangular, about half as long as the basal part of the next plate behind. The first pair of *genital plates* in the male are long and narrow, the terminal joint truncate, strongly excurved beyond the middle, and bordered posteriorly by about six long bristles a third as long as the joint.

In the second pair of plates the basal joint (pedicel) is twice as long as

the rami and three-fifths as wide as long. The second joint of the outer ramus is ovate and twice the length of the first. The inner ramus reaches to the middle of this joint, is broader than in *A. communis*, but of similar shape, and indistinctly bifid at tip.

The *opercular plates* do not reach the tip of the abdomen, but are obliquely truncate, their posterior margins forming a wide re-entering angle. The *anal stylets* are very short, flat and broad. The peduncle is ob-triangular, nearly as broad as long, the tip oblique, the inner edge being the longer and somewhat rounded. The outer ramus is narrow-ovate, obtuse, as long as the peduncle, and seven-eighths the length of the outer ramus. This is also ovate and obtuse, the outer margin nearly straight, the inner convex. All the joints bear many marginal spines, longest at tips of rami.

This species was found in clear, rocky rills in Jackson and Union counties in Southern Illinois.

Asellus intermedius, Forbes. This species is more closely allied to *A communis* than to *A. brevicauda*, but, as will be seen from the description, stands between these two. Its *length*, in adult females, is but 6 mm., its *breadth* about 2 mm. The sides of the *head* diverge posteriorly, and the lateral lobe is smaller than in *brevicauda*, bearing a single spine and a few short hairs. The first *thoracic segment* is narrowed anteriorly, showing the epimera, but is not emarginate. The others are distinctly emarginate on the sides, the emarginations moving gradually backwards, in the succeeding segments, from the anterior to the posterior angles. The free margins of all the segments are strongly spined. The lobe of the hind margin of the *abdomen* is shorter and broader than in *brevicauda*, reaching laterally to the middle of base of each caudal stylet, and extending backward to the middle of length of pedicel. The posterior angles of the abdomen are regularly rounded and indistinct.

The flagellum of the *upper antenna* is nine-jointed, the first joint short, about half as long as fourth.

The *first pair of feet* of the male are stout, the hand two-thirds as wide as long, the palmar margin straight, with a slender tooth at base and a strong conical one at middle. The posterior margin of the propodus is very short, about one-sixth the palmar, the dactyl long and strong, the tip of the claw when closed reaching beyond the base of the hand. The posterior margin of the dactyl is serrate with appressed teeth as in *brevicauda*. The carpus is triangular, the posterior margin straight and usually armed with a strong blunt spine at its distal fifth. The hand of the female is narrower and smaller, its breadth being about half its length. The palm is straight and shorter than in the male, the posterior margin longer, (nearly half the palmar), the two margins forming a wide angle. The spine at this angle is slender, and there is no trace of a tooth on the palmar margin, or on the carpus.

The first pair of *genital plates* in the male are short and broad, the basal joint scarcely longer than wide, the second joint elliptical, broadly rounded at tip and convex both sides, fringed posteriorly and on posterior half of outer margin by a few short hairs. The pedicel of the

second pair is about as long as wide, the rami are as long as the pedicel and sub-equal. The second joint of the outer ramus is elliptical and thrice as long as the first. The inner ramus is nearly half as wide as long, the basal processes obtuse and low, the outer one being almost obsolete. The outer terminal angle is prolonged into an incurved process, the inner provided with a movable (?) excurved claw.

The *caudal stylets* are flat and broad, but narrower than in *brevicauda*, about three-fifths as long as the abdomen. The width of the pedicel is two-thirds its length. The outer ramus is nearly five-sixths the inner and equal to pedicel. Both rami are narrow-ovate, and very obtuse, the inner about four times as long as wide and nearly straight on the outer margin. Both pedicel and rami are spiny on their margins, and the latter are tipped with a few long hairs.

Abundant in the hill-country of southern Illinois, under stones in small streams.

While these two species of Asellus were found in considerable numbers on the first day of my trip, I have never seen a specimen of either in the central or northern part of the state, although I have carefully searched the most varied situations.

Asellus stygius, Packard. This species has been peculiarly unfortunate. Described originally from an injured specimen, its structure and relations were misunderstood and it was made the type of a new genus, (*Caecidotea*, Packard). It was soon re-described by Prof. Cope, under the specific name *microcephalus*; and these imperfect descriptions have since been supplemented by several fragmentary notices in various papers by Packard and Smith.

With a view to giving a more coherent account of it, I have examined many specimens of both sexes and various ages, and have prepared the following description: A detailed comparison of this species with undoubted *Asellus*—especially with the admirable plates of *A. aquaticus* in the *Crustaces d' eau douce de Norvege*, has failed to reveal any structural peculiarities which could possibly serve as the characters of a distinct genus, and I have therefore united it to *Asellus*.

Colorless, blind, narrow, very loosely articulated, sides nearly parallel, 12 to 14 mm. by 2 to 3 mm.

The *head* is a little narrower and longer than the first thoracic segment, narrower in front than behind, with the front margin concave, the front angles rounded, the hind margin nearly straight. It is a little constricted behind the mandibles. The first *thoracic segment* is narrowed a little to the front so as to show the epimera, the sixth and seventh are also much narrower before than behind, and longer than the others. The front angles of the second and third segments are obliquely truncate, the hind angles broadly rounded. All the segments behind the first are slightly emarginate on the sides, the emarginations being carried gradually backward to the posterior angles. The anterior margins of the segments change gradually from concave to convex, and the posterior margins from sinuate to deeply concave. The head and all the segments are slightly pubescent above and bor-

dered laterally with short hairs. The large *abdominal segment* is preceded by two very short ones. The abdomen is about as long as the last two thoracic segments, the hind angles rounded but distinct, the hind margin very slightly sinuate.

The *upper antennae* reach to the tip of the penultimate joint of the pedicel of the lower. Pedicel and flagellum about equal, latter ten to twelve-jointed, bearing a slender olfactory club at tip of each of the four or five joints preceding the last. Joints of pedicel sub-equal in length, but the first twice as large as the second.

The *lower antennae* are about two-thirds as long as the body in the female, in the male somewhat longer. Pedicel about one-third flagellum, five-jointed, fifth and sixth joints each longer than the basal three together. The flagellum contains 75 to 80 joints. The *mandibles* are almost exactly as in *Asellus aquaticus*. The posterior dental plate of the left mandible is nearly as wide as the anterior. The hairs of the marginal fringe are more numerous on the right mandible than on the left, and the anterior eight are toothed instead of plumose.

The *mandibular palpus* is slender, the basal joint a little shorter than the second. On the latter the external angulation is considerably behind the middle. The distal joint is narrow, lunate, (distinctly concave on outer margin) about five-sixths the length of the preceding joint, with about 20, jointed, plumose, marginal hairs, similar to those on the distal half of outer margin of preceding joint. The two plates composing each *mauilla* of the *first pair* are equal in length. The inner is three-fourths as wide as the outer, terminating in five plumose hairs. The outer terminates in twelve strong spines, of which the five outer are stronger and simple, and the seven inner irregularly and bluntly toothed near their tips. The *posterior maxillae* as in *Asellus aquaticus*. The shorter internal hairs on the two outer plates are expanded transversely to the plane of the plate and hollowed lengthwise on the inner face, giving each hair the form of a racing-shell, while both edges of the hair are coarsely toothed. The basal joint of the *palpus of the maxilliped* is quadrate, the fourth joint is about as long as the second and third together. The inner margins of the fourth and fifth are provided with very long hairs. The flagellum (*fouet*, Sars.) is as broad as long, with about eight scattered hairs at tip and several shorter ones on external margin.

The propodus of the *first pair of feet* in the male is very large, broad-oval, two-thirds as wide as long. A strong curved spine is situated at the proximal end of the palm, and two truncate, stout teeth separated by a rounded emargination, near the distal end. The dactyl is strongly curved, especially at base, its inner edge serrate with six acute teeth appressed towards tip. The length of the terminal claw is more than one-third that of the entire dactyl. The convex margin of the dactyl bears a few scattered hairs, and a cluster of four or five near the tip. The carpus is small as in *A. aquaticus*, and spined on its distal margin. The female hand is smaller and narrower, (width to length as 1 to $1\frac{1}{4}$) the palmar margin concave, the pair of truncate teeth replaced by a single smaller conical one which is sometimes obsolete. The other differences are trivial. The *legs* become longer

behind, the tip of the second pair reaching as far as the base of the propodus of the seventh. The *abdominal sexual plates* of the male are in two pairs, as usual. (See plate). The corresponding plates of the female are but one pair, rather narrowly ovate, ciliated at tip and on posterior two-thirds of outer margin, with a few short spines at the base of the inner edge. The external ramus of the next pair—serving as a gill-cover—bears a terminal fringe of plumose hairs and a few short spines at base on outer margin. The inner ramus—first gill —is oblong, two-thirds the length and breadth of the outer. Both the pedicel and rami of the *caudal stylets* are slender and cylindrical, the former about as long as the last two joints of the last pair of legs, the latter tipped each with a cluster of bristles, the inner about two-thirds as long as the pedicel, the outer varying from one-quarter to two-thirds the inner. The length of the rami varies greatly with age and sex. In many old males the inner is very long and the outer minute. There are four pairs of *incubatory lamellae* in the female, each pair overlapping by their rounded inner ends, except the first, which are shorter and have the anterior internal angles emarginate.

The description has been given above in greater detail than would otherwise have been necessary, in order to settle the question of genus. The species is found quite frequently in deep wells of central Illinois, in company with, but much more abundant than, *Crangonyx mucronatus.*

After a long period of heavy rains during the last summer had greatly swelled the subterranean streams which these species inhabit, they appeared at the surface in springs, and even at the mouths of tile drains, in such numbers that a hundred could be taken in an hour. A few females were observed with eggs at this time. (July).

Eubranchipus serratus, Forbes. This species seems to replace the *E. vernalis, Verrill*, of the Eastern States, to which it is closely allied. An important character, constant in the large number of both sexes which I have examined, is found in the *abdominal segments*, which are narrowed in front, with rounded anterior angles, while the posterior angles are produced backward, giving a decidedly serrate appearance to the abdominal margin. The last two abdominal segments are closely united and broader than the preceding.

Tne *antennae* extend a little beyond the eyes, and terminate in a cluster of about five slender olfactory clubs. The *frontal appendages* of the male are considerably longer than the claspers, to the front inner base of which they are attached, the line of attachment being parallel to the length of the basal joint. Their form is irregularly oval, the inner edge being regularly convex on its distal three-fourths and the outer sinuate—convex on basal two-thirds, and slightly concave on terminal third. Both margins are pectinate, except near base, with thick blunt teeth, which are longest on the basal half of the outer margin, where they are as long as the undivided part of the appendage is wide. At the middle of this margin the teeth become suddenly shorter. On the inner margin they are longest near the middle, regularly lessening towards each end. The under (posterior) surface of the appendage, as well as the teeth, is set with short spines, each springing from an inflated

base. The *claspers* of the male are shorter and stouter than in *E. vernalis.* The basal joint is soft and inflated and bears a corneous rounded tubercle at its inner base.* The second joint is stout and regularly incurved, strongly angulated at its base in front where it is received into the first joint. A long strong tooth, about half as long as the joint, extends backward and a little inward from near its base. The rounded tip of this tooth is thickly set with minute, low, circular elevations, each with a central depression, within which is a disk-like elevation, the whole having the appearance of a minute sucking disk. The tip of the clasper is expanded and flattened within so that the inner (anterior) part has a spatulate form, while the opposite surface rises into a thick prominent ridge, giving to a transverse section of the tip the form of the letter T. The *anal appendages* are linear-lanceolate, as long as the last four segments of the abdomen, and plumosely haired to the base. The ovisac of thefemale is as broad as long, three lobed behind with the middle lobe the largest.

Length of a full grown male, including anal stylets, 20 mm., width 6 mm., across eyes 4 mm., clasper 4.5 mm., frontal appendage 5 mm. by 3 mm. The largest females were a little more slender than the males. This species was first observed at Normal, Ill., in clear pools, in April, 1876. About a fortnight afterward it entirely disappeared. Another species has been sent me by Prof. Bundy, by whom it was taken in Wisconsin.

Canthocamptus illinoisensis, Forbes. Length 1 mm., color light red. Head and first segment united; five abdominal segments in male, four in female. The suture between the first and second segments is not wholly obliterated above in the female.

Last abdominal segment is deeply and acutely emarginate. Branches of *furca* as wide as long, inner bristle plumose, a little longer than abdomen; outer plumose only on outer side, about half the length of the inner. The second to fifth *abdominal segments* have each a row of spinules along ventral portion of posterior margin.

Male with *anterior antennae* composed of seven joints, the fourth joint very short. The front outer angle of the third is produced, the blnnt process bearing three long bristles surrounding a slender olfactory club which is as long as the three following joints. The penultimate joint bears a strong spine or slender appressed process at the middle of its posterior margin. The five outer joints constitute the grasping organ. The *posterior antennae* bear five long bristles at tip, three of which are made prehensile by the occurrence of from eight to twelve short articulations in the middle of the hair, allowing it to be bent forward. At the base of these articulations on the outer bristle, are two short spinules. Two nearly longitudinal rows of five or six strong, short spines each appear on the under surface of the outer joint of the antennule. The secondary flagellum, borne as usual on the middle of the basal joint, is not articulated, and bears four long bristles, two terminal and two on distal half of inner side. The outline of the *mandible* is exactly like that figured by Claus, but it bears about ten teeth, the upper thick and blunt, the inner sharp, slender and longer. Several are notched

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*Wanting in *vernalis*

at tip. The lower angle bears a long simple bristle. *Mandibular palpus* two-jointed, second joint with three long terminal hairs and a shorter spine attached at basal third of anterior margin, jointed at base and directed towards tip of joint, like a dactyl. The *maxilla* and *maxillary palpus* are scarcely to be distinguished from those of *C. staphylinus*.

The first maxillipeds are three lobed, the outer lobe constituting a long, strong claw. The second and third are about one-third as long as the first, and bear each one strong simple spine and one weak branched hair. The inner lobe is widest, about two-thirds as wide as long. The dactyl of the *posterior maxilliped* is spinous on its inner edge, and the same edge of the hand is ciliate and bears a short, stout, sparingly plumose bristle at its base, just beyond the tip of the closed dactyl. The width of this joint (the second) is nearly half its length.

Basal joint of inner ramus of *first pair of legs* nearly or quite as long as outer ramus, the second wider but only half as long as the third, and obliquely truncate. Inner ramus of *third pair of legs* in male is three-jointed, the outer two-jointed, chelate. The finger is ovate, truncate, terminating in two long plumose hairs. The dactyl is linear, curved at base, and twice as long as finger. The inner ramus of the *fourth pair of legs* is about half as long as outer, two-jointed, basal joint short, terminal joint about as long as middle joint of outer ramus. The *fifth pair of legs* is best developed in the female. In the male the length is not over one-third the width. The basal portion bears three plumose hairs on its very broadly rounded anterior margin, of which the innermost is longest. The outer plate is nearly orbicular and bears five spines on its terminal margin, of which the second from the internal angle is the longest. *Genital plates* found in male at posterior border of first abdominal segment, beneath, are short, slightly expanded internally, with internal angles rounded, and externally bear three sub-equal bristles, jointed at base, the inner largest and strongest and semi-plumose. The *antennae* of the female are eight-jointed, extending backward to the first free segment. The basal joint of the *fifth pair of legs* is sub-elliptical in outline, with the basal half produced externally into a broad, triangular process which bears the second joint on its posterior margin. The free end of the basal joint bears six large plumose bristles of which the inner is longest. The greatest width of the joint is nearly equal to its greatest length. The second or outer joint is ovate, sub-truncate, spined on each margin, and bears four plumose bristles at tip and one at the middle of its outer margin. Its length is about twice its breadth. Same habitat as the following :

Diaptomus sanguineus, Forbes. This species differs in some slight respects from the genus to which I have assigned it, as characterized by Claus, (*Die Frei Lebenden Copepoden*) but not sufficiently to constitute it a new genus. In the male the fifteenth to eighteenth joints of the right antenna are thickened, the teeth of the mandible are not at all emarginate, the first joint of the terminal portion of the lower maxilliped is smaller than the others, and the right foot of the fifth pair in the male wants the inner ramus, which is perhaps represented by an immovable blunt spine at the

inner inferior angle of the second joint. The *body* of this species is broader than in *D. castor*, the color is throughout a deep red. The *antennae* are nearly as long as the body, the eighteenth joint in the female reaching to the base of the abdomen. The second tooth of the *mandible* is larger than any of the remaining six of the series, and is separated from the third by an interval equal to the width of the tooth. A short feathered bristle appears at the lower end of the row of teeth. The secondary appendage of the *mandibular palpus* is four-jointed, and bears six bristles at its tip and inner margin. The *maxilla* has the normal structure, the basal plate, the two cylindrical processes and the outer ramus (flabellum) and the inner ramus being all present and symmetrically developed. The *first maxilliped* is nearly as broad as long, and bears 15 long hairs on its margin. The basal segment of the *second maxilliped* presents four rounded processes on its inner margin, of which the first is smallest and bears one bristle, the second and third are subequal and bear respectively two and three bristles, and the fourth is largest, is much produced inferiorly (the rounded lower end being finely ciliate) and bears four bristles.

The *fifth pair of legs* in the female is bi-ramose, the inner branch straight, slender, not jointed, terminating in two short claws; the outer strong, two-jointed, terminating in a single slightly serrate claw. The second joint of this branch bears two slender bristles near the middle of the outer margin, otherwise the leg is destitute of hairs and spines. The *legs of the fifth pair* in the male are very dissimilar. The right leg consists of five joints; the basal quadrate; the second about twice as wide as long, enlarging distally and bearing a strong blunt spine at the inner, and a longer one at the outer, inferior angle. The third joint is sub-quadrate, the fourth clavate, bearing a long bristle at the middle of its outer margin; and the fifth constitutes a slender incurved dactyl as long as the preceding joint, slightly serrate on the distal half of its inner margin, and so jointed as to close back against the inner margin of the fourth joint, which thus acts as a hand. The left leg reaches about to the tip of the third joint of the right. Its pedicel contains two large quadrate joints; the outer ramus two small joints, of which the terminal one is forcipate at the tip, the inner ramus a single slender joint on which no armature was seen. The *furca* bears at tip of each branch four long feathered hairs, and a fifth smaller simple one at the posterior internal angle. A sixth large and plumose hair is borne at the posterior third of the outer margin.

Found rather abundantly in a pool fed by a slow spring, in March and April, at Normal, Illinois. In several characters, especially those of the mouth appendages, this species seems closely allied to Ichthyophorba, bearing to some species of that genus a much closer resemblance than to *D. castor*, if the figures in Baird's British Entomostraca are at all to be relied on.

KEY TO THE SPECIES MENTIONED IN THE PRECEDING PAPER.

The general neglect of our crustacea by the students of our local natural history, if not a discredit, is at least a misfortune; for no other class of animals accessible to the inland student will repay study so promptly and so generously; since while the species are comparatively very few, they present many and extreme diversities of form and structure. The differences between the *orders* of this class,—between the *families*, even, of some of the orders,—are more profound, penetrate farther into the interior of the animal, affecting structures commonly far more stable, than do the differences between the other *classes* of the sub-kingdom. In the same order hearts may be present or absent, in the same tribe gills may be filamentous or lamellate, in the same genus so complex an organ as the eye may be well-developed or entirely wanting; and everywhere not external form alone seems plastic, but internal structure also. Indeed, this is but an instance of a more general truth. In every well founded sub-kingdom the lowest class stands nearest the point of common origin,—illustrates, therefore, most closely by its diversities the first divergencies of the group from which the later groups have sprung In this primeval group structure must have been much more unstable than in the later higher ones, else the stable structural characters which now distinguish classes could never have arisen; and in the lowest present class, which has departed least from the condition of this primeval group, this instability of structure may be expected to persist,—structural differences will have less "value" for purposes of classification.* Hence in the study of the few examples of this lowest class of arthropods, we rapidly acquire a more fruitful knowledge of nature's multiform adjustments, encounter more numerous and suggestive illustrations of her general laws, than by much longer and more elaborate study of the higher groups. For the amateur and the beginner the crustacea have further a peculiar interest from the fact that the transparency of some of the smaller forms makes possible the direct and easy study of the entire living organism. Nothing better could be devised for the luminous demonstration of the leading facts of animal physiology. In a single colorless *Asellus* or *Crangonyx* may be observed at leisure, under a low power of the microscope, the respiratory movement, the circulation of the blood, the motions of the heart and the actions of its valves, the contraction and relaxation of muscular fiber, the processes of digestion, as well as the general and minute anatomy of the entire animal.

The economical interest of the subject should not be overlooked. With the progressive settlement of the country we must look forward to a continuous advance in the price of animal food, and with this advance the question of our inland fisheries will rise yearly into higher prominence. But intelligent measures for the increase and preservation of our edible fishes

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*This principle, that *structural characters diminish in importance downward*, has been ignored, I think, by some of our recent ichthyologists.

presuppose an acquaintance with the natural history of our crustacea, which are as essential to fishes as insects are to birds.

With a view to removing some of the many difficulties which have prevented a more general study of this captivating and important class, I add to the foregoing paper the following simple synopsis of the species mentioned, which it is hoped that any intelligent student may use successfully. It is of course a mere compilation designed as a temporary aidto local students. A few species from Lake Michigan have been included which have not yet been found within the limits of the state, but which must nevertheless occur there at least occasionally.

CLASS CRUSTACEA.

Arthropoda usually with jointed abdominal appendages and two pairs of antennae. All save a few minute forms with more than four pairs of legs. Respiration by distinct gills, by gill-feet, or by the general surface of the body.

ORDER DECAPODA.

Head and thorax consolidated, forming a cephalo-thorax ; eyes compound, on flexible stalks.

FAMILY ASTACIDAE.

Abdomen depressed, carapace (1) with a transverse channel, edge united with the epistoma (2) ; gills very numerous, composed of filaments ; the three front pairs of feet chelate (3), the first much the largest.

Genus Cambarus.

The fifth pair of legs without gills ; last segment of thorax movable. Rostrum (4) simple or with one tooth on each side. First abdominal legs of male (5) more less divided.

a

Oblique tubercle on front margin of third joint of third and fourth pairs of legs of male.

C. acutus, Girard. Areola (6) much wider behind than before. Thorax densely tuberculate on sides, nearly smooth above. Movable finger much longer than inner side of hand.

C. troglodytes, Leconte. Areola narrower behind than before. Thorax granulate on sides, strongly punctate above. Movable claw not longer than hand.

aa

Oblique tubercle on third joint of third pair of legs of male, none on fourth pair.

b

First abdominal legs of male not distinctly bifid.

C. gracilis, Bundy. Rostrum broad, short, toothless ; finger not hairy ; first abdominal leg toothed but not recurved at tip.

C. stygius, Bundy. Rostrum long, triangular, with small apical teeth; outer margin of finger hairy; first abdominal legs recurved at tip and three-toothed.

bb

First abdominal legs of male distinctly bifid.

c

C. obesus, Hagen. First abdominal legs short, thick, branches stout, tips recurved, obtuse. Areola linear.

cc

First abdominal legs of male with branches usually long and slender.

d

C. immunis, Hagen. Both branches gradually, strongly and equally recurved. Rostrum short and conical.

dd

Branches not strongly and equally recurved.

e

C. propinquus, Girard. Rostrum carinated (7) on middle of anterior half.

ee

Rostrum not carinated.

C. placidus, Hagen. Rostrum excavated, margins thickened; maxillipeds not hairy beneath; greatest width of hand contained about three times in length of outer margin, inner edge of outer finger not bearded, forearm without two rows of distinct spines beneath.

C. virilis, Hagen. Rostrum sub-excavated, margins thickened, hardly converging; antennal plates not longer than rostrum; maxillipeds bearded without, beneath and within; greatest width of hand about two and one-third times in length of outer margin, outer finger bearded within, forearm with two rows of distinct spines beneath.

C. wisconsinensis, Bundy. Rostrum nearly flat above, narrowed in front; antennal plates longer than rostrum; maxillipeds hairy within and below at base.

FAMILY PALAEMONIDAE.

Abdomen compressed. Carapace without transverse channel, its lower edges free throughout. Gills composed of plates. The third pair of feet never chelate.

Genus Palaemon.

Rostrum long, compressed, serrate; two inner antennae with flagella (8), mandibles (9) with three-jointed palpus (10), first pair of legs slender, second stronger, both chelate.

P. ohonis, Smith Rostrum slightly curved upward at tip, about twelve teeth above and three to five below. Hand of second pair of legs about once and a half the length of the carpus (11).

Genus Palaemonetes.

Differs from *Palaemon* by the absence of mandibular palpi

P. exilipes, Stimpson. Rostrum nearly straight, seven or eight teeth above, one or two below. Hand of second pair of feet about two-thirds as long as carpus.

FAMILY MYSIDAE.

Feet more than five pairs, slender, often bearing palpi, none chelate, usually rudimentary on the abdomen. Gills wanting.

Genus Mysis.

Six pairs of thoracic feet, each with two many-jointed branches; three pairs of maxillipeds (12). Inner antennae with two flagella. Fourth pair of abdominal legs in male very long, styliform, directed backwards.

M. relicta, Loven. Cephalo-thorax about one-third total length, broader behind than before. Pedicel (13) of inner antennae a little longer than the eyes, three-jointed, first joint about as long as second and third together. Inner flagellum shorter and more slender than outer.

ORDER AMPHIPODA.

Body commonly compressed, of fourteen segments; thoracic segments not consolidated, eyes sessile if present. Gill plates thoracic.

FAMILY ORCHESTIDAE.

Upper antennae shorter than lower, no secondary flagellum (14). No palpus to mandible. Epimera (15) large. Last pair of abdominal legs not branched.

Genus Hyalella.

First two pairs of feet sub-chelate (16), the second the larger; upper antennae as long as peduncle of lower; telson (17), short, stout, entire; palpus of maxillipeds five-jointed; first pair of maxillae with very short one-jointed palpi.

H. dentata, Smith. First and second abdominal segments with a prominent tooth on middle of hind margin, second hand of male about three times as broad as first, flagellum of lower antenna commonly but little longer than that of upper.

FAMILY LYSIANASSIDAE.

Body little compressed, first two pairs of feet small and weak, epimera of first four segments very deep.

Genus Pontoporeia.

Upper antennae with short secondary flagellum; first two pairs of legs very short, the first sub-chelate, the second not, seventh pair with basal joint very large.

P. hoyi, Smith. First pair of hands with one to three small slender spines at tip of closed claw. About seven elongated papillae on the second to fifth segments of the sternum (18). Upper antennae short, about as long as head and first three thoracic segments; flagellum about nine-jointed.

P. filicornis, Smith. Upper antennae reaching nearly to tip of abdomen, flagellum of about thirty-three joints, the terminal ones very long and slender. Secondary flagellum of four segments.

FAMILY GAMMARIDAE.

Both antennae well developed, the upper long, slender, filiform, usually immediately above the lower, which are inserted into a notch at the front angle of the head. First and second feet sub-chelate. Eyes compound, commonly between upper and lower antennae.

Genus Gammarus.

No rostrum. Three last abdominal segments each with two or more clusters of short stiff spines on hind margin. Secondary flagellum and mandibular palpus present. Last pair of abdominal legs two branched; telson double.

G. fasciatus, Say. Secondary flagellum as long as second segment of peduncle (19), and composed of five or six segments. Fourth, fifth and sixth abdominal segments each with three clusters of spines on hind margin.

Genus Crangonyx.

No clusters of spines on posterior abdominal segments. Telson single; last pair of abdominal legs with inner branch rudimentary or wanting. Peduncles of the two pairs of antennae sub-equal. The first two pairs of feet sub-equal.

C. gracilis, Smith. Eyes evident. Hind angles of first three abdominal segments each ending in a sharp tooth. Outer branch of last pair of legs about twice as long as peduncle; inner branch very small. Telson short, emarginate.

C. mucronatus, Forbes. No eyes. Hind angles of first three abdominal segments rounded. Outer branch of last pair of legs shorter than peduncle, inner minute. Telson of male a slender spine about as long as first three abdominal segments.

ORDER ISOPODA.

Body commonly depressed; thoracic segments not consolidated; eyes, if present, compound, sessile. Gill plates beneath abdomen. The last four pairs of thoracic legs similar, and differing from the first three pairs. Last pair of abdominal legs more or less styliform.

FAMILY ONISCIDAE.

Abdomen many-jointed, last segment small, caudal stylets (20)well exserted. Mandibles without palpi. Inner antennae obsolete.

FAMILY ASELLIDAE.

Body very flat, loosely jointed. Last abdominal segment very large, shield-like, comprising nearly the whole abdomen. Upper antennae short, lower very long. Only first pair of feet sub-chelate. Mandibles with palpi.

Genus Asellus.

First pair of feet sub-chelate; last thoracic legs not elongate; first pair of abdominal appendages in female (first two pairs in male) small, forming short plates; outer ramus of next pair serving as gill-covers; caudal stylets elongate.

A. brevicauda, Forbes. Head with hind angles laterally extended, forming broad spinous lobes; front angles of first thoracic segment notched, no lateral notches on thoracic segments; tip of abdomen with broad rounded lobe, pedicels of caudal stylets as broad as long, palm of hand with two strong spines.

A. intermedius, Forbes. Head with small lateral lobes. First thoracic segment with front angles entire, others notched laterally; hind angles of abdomen not distinct, pedicel of caudal stylet twice as long as wide.

A. stygius, Packard. Slender, loosely-jointed, colorless and blind; caudal stylets slender, cylindrical, abdomen not lobed behind.

ORDER PHYLLOPODA.

Feet, ten to sixty pairs, broad and flat, two or three-lobed; mouth with mandibles and maxillae, antennae usually small, not used for swimming.

FAMILY BRANCHIPODIDAE.

Body long and slender, no carapace, thoracic segments distinct, eyes on stalks, second antennae converted into clasping organs. Eleven pairs of gill-feet. Female with egg-pouch at base of abdomen.

Genus Eubranchipus.

Head large, claspers (21) of male thick and strong, with a tooth at base of second joint; a pair of simple, flat, serrate, membranous appendages attached to front of head; caudal appendages long, lanceolate, with many feathery hairs. Egg-pouch short, thick, broad-oval.

E. serratus, Forbes. Frontal appendages longer than claspers, irregularly ovate, deeply serrate. Tip of claspers flattened within, abdomen somewhat serrate.

FAMILY ESTHERIADAE.

Compressed; head and body enclosed in a bivalve shell. Eyes sessile; feet, ten to twenty-seven pairs.

Genus Limnetis.

Shell circular, globose, no beaks or lines of growth. Inner antennae two-jointed; feet ten or twelve; abdomen truncate.

ORDER CLADOCERA.

Body enclosed in a bivalve shell, head free; abdomen acutely forked; eye single, large. Lower antennae form large branched swimming organs; feet four to six pairs.

FAMILY DAPHNIADAE.

Upper antennae minute, one or two-jointed; five pairs of feet, all enclosed by carapace. Intestine nearly straight.

ORDER OSTRACODA.

Biting mouth, one eye, two pairs of antennae, one for swimming; bivalve carapace enclosing head and body. Feet one to three pairs.

FAMILY CYPRIDAE.

Upper antennae long, many-jointed, with a tuft of long hairs; lower stout and foot-like; two pairs of feet.

ORDER COPEPODA.

Body more or less distinctly segmented, and distinguishable into regions; two pairs of antennae, one or two antennae often prehensile. No carapace or bivalve shell; three pairs of mouth-parts and five pairs of swimming feet. Females with external egg-sac.

FAMILY CYCLOPIDAE.

Both anterior antennae modified for grasping in male. Posterior antennae four-jointed, not branched. Fifth pair of legs cylindrical, alike in both sexes. One eye, with two lateral lenses; two egg-sacs.

Genus Cyclops.

Body broad in front, slender behind, of ten segments in males, nine in females. Head and first thoracic segment consolidated. Palpus of mandible rudimentary, a tubercle bearing two bristles. Fifth pair of feet obsolete.

FAMILY HARPACTIDAE.

Body linear, cylindrical. Both anterior antennae of male modified for grasping. Posterior antennae branched, and armed with jointed bristles. The fifth pair of feet usually lamellate. Eye single. Commonly a single egg-sac.

Genus Canthocamptus.

Branches of the first pair of feet similar, three-jointed, the inner branch the longer, its first joint very long. Palpus of mandible simple, two-jointed. First antennae eight-jointed. Secondary branch of second antennae very short, one or two-jointed.

C. illinoisensis, Forbes. Minute, light red; five abdominal segments in male, four in female. Branches of furca (22) as wide as long. Of the bristles at their tip, the inner is about as long as the abdomen, the outer half the inner. Mandible with about ten teeth.

FAMILY CALANIDAE.

Body elongate; anterior antennae very long, usually of twenty four or twenty-five joints. In males the right—rarely the left—is modified for grasping. Posterior antennae large, two-branched. One egg-sac.

Genus Diaptomus.

Fifth pair of feet unlike in males, inner branch of right foot rudimentary or wanting. This foot is converted into a grasping organ, as is also the right antennae of the male. Antennae twenty-five jointed. Fifth thoracic segment distinct. Abdomen of male with five joints, of female with four.

D. sanguineus, Forbes. Color crimson. Right foot of male without inner ramus, the last two joints forming a hand and dactyl. Each branch of the furca bears six plumose hairs, of which the inner is slender and short. The teeth of the mandible are entire.

1. The crust covering cephalo-thorax on back and sides. 2. Under surface of head between the lower antennae. 3. Furnished with nippers. 4. Projection from front of head, between antennae. 5. In the male crawfish the first abdominal legs are stiff and unlike theothers; in the female similar to the others, but rudimentary. 6. Space on back of thorax between the two longitudinal curved lines. 7. Ridged longitudinally. 8. The many-jointed terminal part of antennae. 9 Front pair of jaws. 10. Jointed feelers. 11. Joint preceding hand. 12. Hind pairs of jaws. 13. The thick, longer-jointed basal part of antennae. 14. A very short flagellum attached beside the principal one. 15. Side-plates concealing attachment of legs. 16. Last joint claw-like, shutting against the enlarged preceding joint like the blade of a pocket-knife against its handle. 17. Rudimentary last segment of the body. 18. Under surface of the body between bases of the thoracic legs. 19. Undivided basal joint of leg. 20. Pair of appendages at tip of abdomen. 21. The strong, jaw-like organs in front of head. 22. The forked tip of the abdomen.

APPENDIX.

Descriptions of the following extra-limital species are added for the purpose of calling the attention of collectors to them, as it is very likely that they will be found in the state. The descriptions of crawfishes are furnished by Mr. Bundy, who has made a careful study of the species of Cambarus found in this and adjoining states.

C. sloanii, Bundy. Rostrum quadrangular, subdeflexed, slightly concave, toothed in front, acumen long, acute, straight, cephalo-thorax, finely punctate above, granulate on sides, front margin angulated, lateral tooth long, acute; epistoma wider than long, narrower in front, concave below, apex emarginate; third maxillipedes smooth below, hairy within, hands short, thick, wide, smooth, fingers short, straight, not gaping at base, generally tipped with black, arm and wrist nearly smooth, at most with a few blunt teeth; third legs with third joints hooked; first abdominal legs short, bifid, outer part slightly longer, flattened, bent outward at apex, slightly recurved, acute, tubercles at inner base small, inter-pedal space once and one-half longer than wide. The female has ventral ring rhomboid, posterior angle swollen, irregularly tuberculate, fissure transverse, anterior angle depressed. Habitat: Southern Indiana, Kentucky (*Dr. Sloan*).

C. debilis, Bundy. Rostrum wide, quadrangular, subdepressed, concave above, foveola at base, margins nearly parallel, anterior teeth prominent, acumen acute, flat, smooth, cephalo-thorax subdepressed, punctate above, granulate on sides, lateral tooth acute, dorsal area narrow, wider behind,

antennal plates longer than rostrum, apical spine acute; antennae slender, long, reaching to base of telson, epistoma much wider than long, truncate, maxillipedes barbate on inner side and below; inner margin of hand and movable finger with two rows of teeth, contiguous margins of fingers tuberculate, exterior one hairy at base, both fingers ribbed and punctate above, third joint of third thoracic legs hooked; first abdominal legs long, bifid, nearly straight, exterior part longer, recurved, interior part recurved, obtuse, not enlarged near apex, tubercles on inner basal angles small. This species resembles the above, but differs from it in having a wider, more concave rostrum, with parallel sides, a depressed dorsum, wider epistoma, more coarsely bearded maxillipedes, longer abdominal legs, and the absence of enlargement near apex of interior part. Habitat: Baraboo river, Ironton; Wisconsin river, Sauk City, Wisconsin.

Eubranchipus bundyi, Forbes. This species, sent me by my friend Prof. Bundy, was taken by him at Jefferson, Wis. The specimens seen were somewhat smaller than average individuals of *E. serratus*, the thorax shorter and the abdomen more slender. The latter is similar to the abdomen of *E. vernalis*, while the claspers and frontal appendages are more like those of *E. serratus*.

The *antennae* extend about one-third their length beyond the eyes. The *frontal appendages* are long and narrow, widest at base and regularly tapering, serrate within and on outer margin of tip with short blunt even teeth. The under surface is covered with short blunt spines or tubercles.

These appendages are attached by a transverse line to the front of the head, just within the base of the claspers, and are about three times as long as the basal joint of the latter.

The *claspers* resemble in size, general form and position those of *E. serratus*. The tubercle at the base of the first joint is larger and situated farther forward, extending far enough to the front to meet its fellow of the opposite side before the labrum. The opposed edges are somewhat roughened. The *labrum* is large and extends forward in the form of a stout tubercle, truncate at its extremity. This process is embraced by the concave posterior internal margins of the basal tubercles of the claspers The second joint of the clasper is thick at base, but tapers more rapidly than in *E. serratus*. The long and slender tooth of the latter is replaced by a thick rounded tubercle extending directly inward and covered by elevated disks, or truncate papillae, like the tip of the tooth in the species just mentioned. Unlike the latter, these papillae are wanting at the tip of the joint, which is expanded and distinctly bifid.

The margins of the *abdomen* are not distinctly serrate, the last segment is not connate with the penultimate, nor is the tip of the abdomen broader than the preceding segments.

The *caudal stylets* are broad and blunt, not rounded at base, usually a little longer than the last three abdominal segments, and ciliate their whole length. The ovisac of the female is nearly as broad as long, with a large median lobe behind, and no other posterior processes.

EXPLANATION OF THE PLATES.

ILLINOIS CRUSTACEA.

1, 2, 3, 4, 5, 6, 7, *Crangonyx mucronatus*, Forbes.

1. Head of female, with pedicels of antennae.
2. Posterior abdominal segments of male, with their appendages.
3. One of 1st pair of hands of male.
4. One of 2d pair of hands of male.
5. Telson and last pair of stylets of female.
6. One of 1st pair of hands of female.
7. One of 2d pair of hands of female.

8, 9, 10, 11, *Asellus brevicauda*, Forbes.

8. Hand of male, × 20.
9. One of 1st pair of genital plates of male, × 38.
10. One of 2d pair of genital plates of male, × 19.
11. One of caudal stylets.

12, 13, 14, 15, 16, *Asellus intermedius*, Forbes.

12. Hand of male, × 45.
13. Hand of female.
14. Last segment of abdomen, with caudal stylets, × 17.
15. One of 1st pair of genital plates of male, × 38.
16. One of 2d pair of genital plates of male, × 38.

17, 18, *Asellus communis*, Say.

17. One of 1st pair of genital plates of male, × 18.
18. One of 2d pair of genital plates of male, × 18.

19, 20, *Asellus stygius*, Pack.

19. One of 1st pair of genital plates of male.
20. One of 2d pair of genital plates of male.

21, 22, 25, *Eubranchipus serratus*, Forbes.

21. Abdomen, × 3.
22. Frontal appendage of male, × 10.
25. Claspers of male, from before, × 6.

23, 26, 27, 31, *Canthocamptus illinoisensis*, Forbes

23. One of 5th pair of legs of female.
26. One of anterior maxillipeds, × 250.
27. One of 3d pair of legs of male.
31. One of posterior maxillipeds.

24, 28, 29, 30, *Diaptomus sanguineus*, Forbes.

24. One of posterior maxillipeds.
28. One of anterior maxillipeds, × 66.
29. 5th pair of legs of male.
29a. Tip of inner ramus of left leg.
30. One of 5th pair of legs of female.

PARASITIC FUNGI.

PLATE I.

1, 2, 3 & 4, *Cystopus candidus*, Lev.

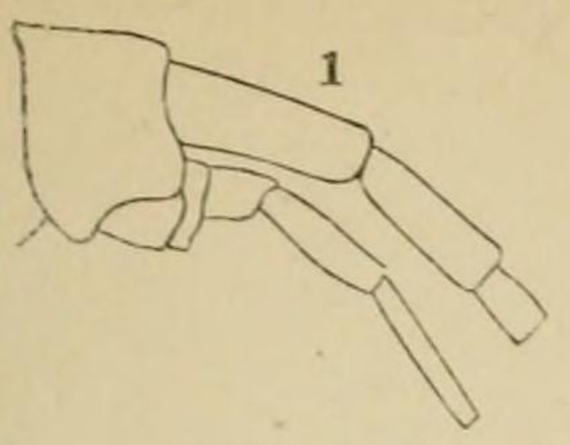
1. Portion of cabbage leaf with spots and holes caused by fungus.
2. Conidia, magnified 360 diam. After Cooke.
3a. Oogonium; 3b, antheridium; 3c, oospore, magnified 400 diam.
4. Oospore (the developed oosphere) ruptured, exhibiting zoospores, magnified 400 diameters. After De Barry.
4a. Free zoospores from oospore. 3 & 4 after De Barry.

5, 6, 7, 8, 9, 10 & 11, *Undetermined Parasite on Green-house Plants.*

5. Portion of petiole of geranium, with fungus; natural size.
6. Fertile hyphæ and conidia, magnified about 175 diam.
7. Conidium magnified 650 diam.
8. Conidium twelve hours after sowing in water, outer coat ruptured and the inner protruding in the form of a tube, magnified 320 diam.
9. Same conidium, thirty hours after sowing, magnified 325 diam.; germinating tube issuing from two points.
10. Supposed oospore, (see text) magnified 390 diam.
11. Longitudinal section of stem of Achyranthus, with mycelium, especially following the vascular bundles, a. Also seen penetrating cells of pith, c.

PLATE II.

1. *Melanispora populina*, Lev. a, Portion of leaf of Populus monilifera, natural size; b, Summer spores.
2. *Botryopium pulchrum* (?) Corda. Magnified about 75 diam.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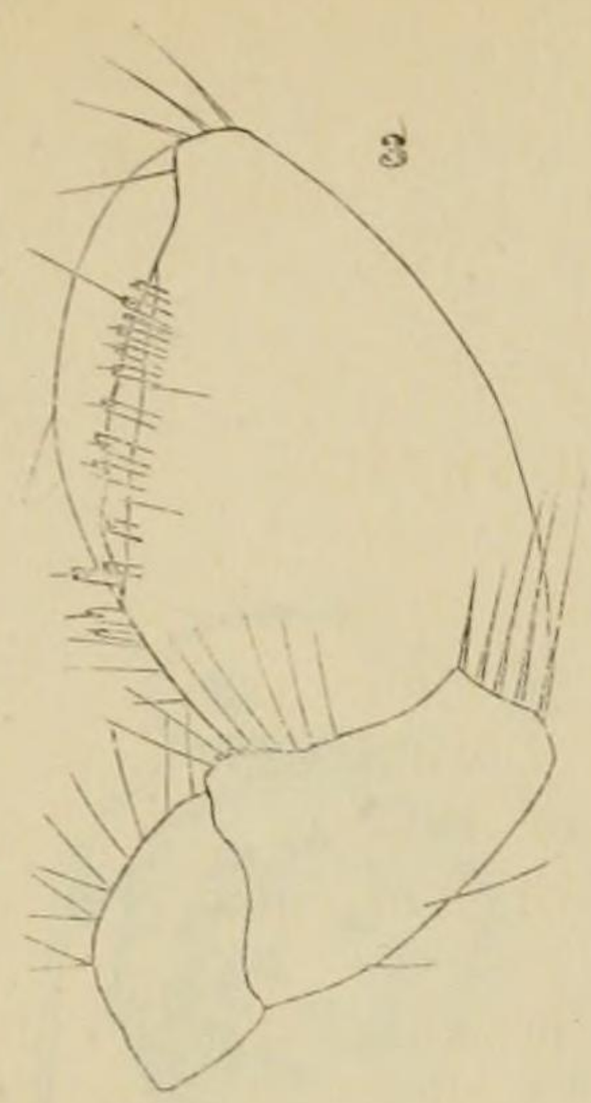
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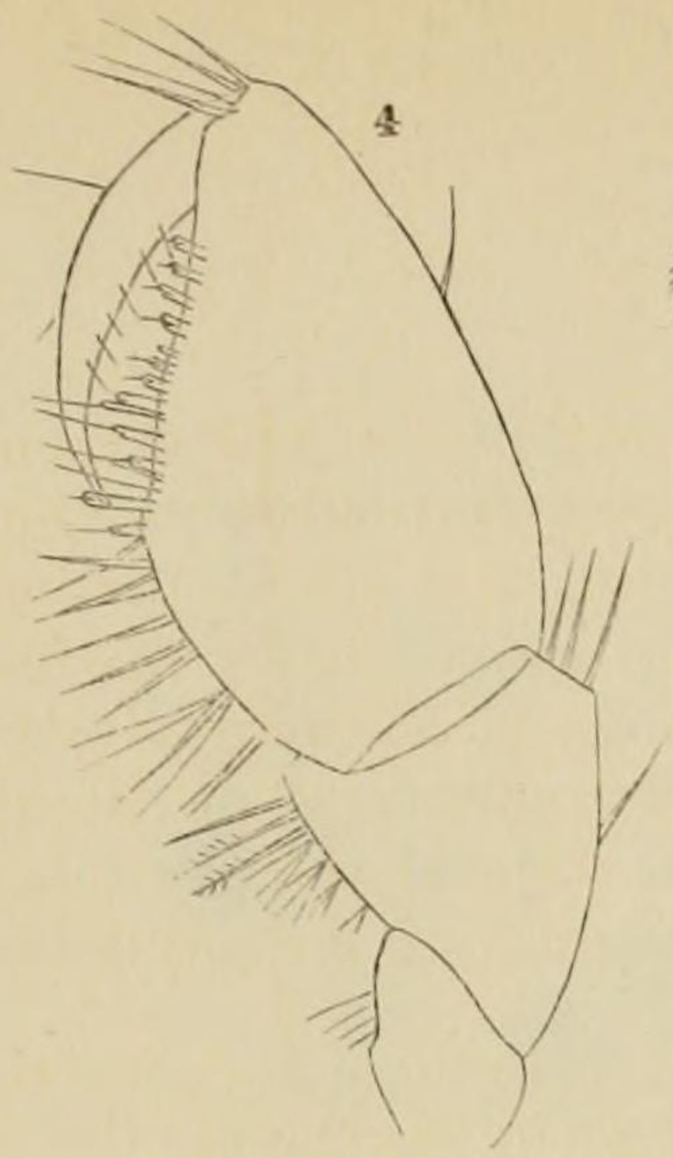
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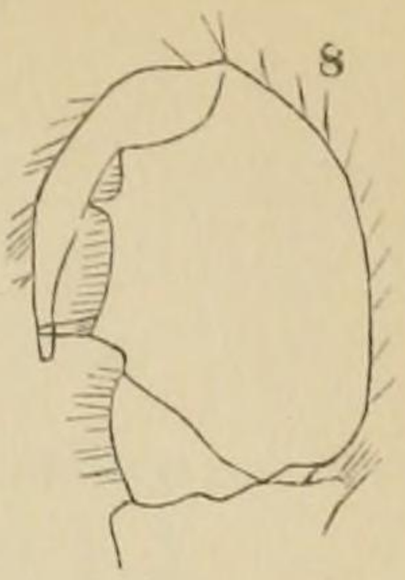
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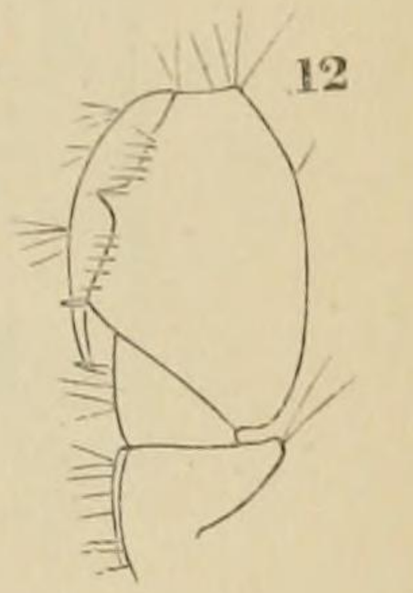
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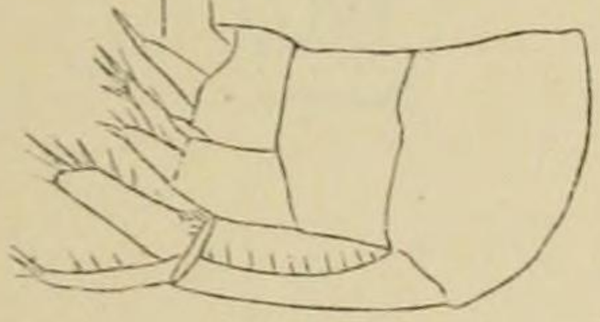
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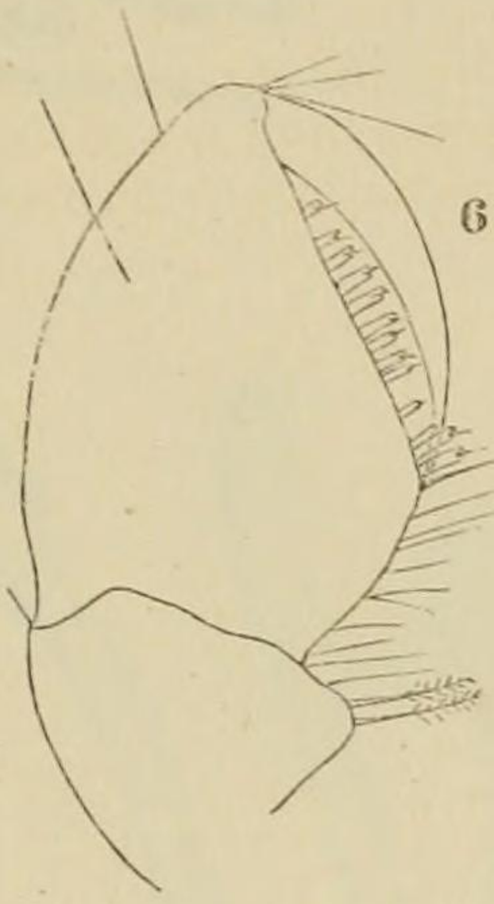
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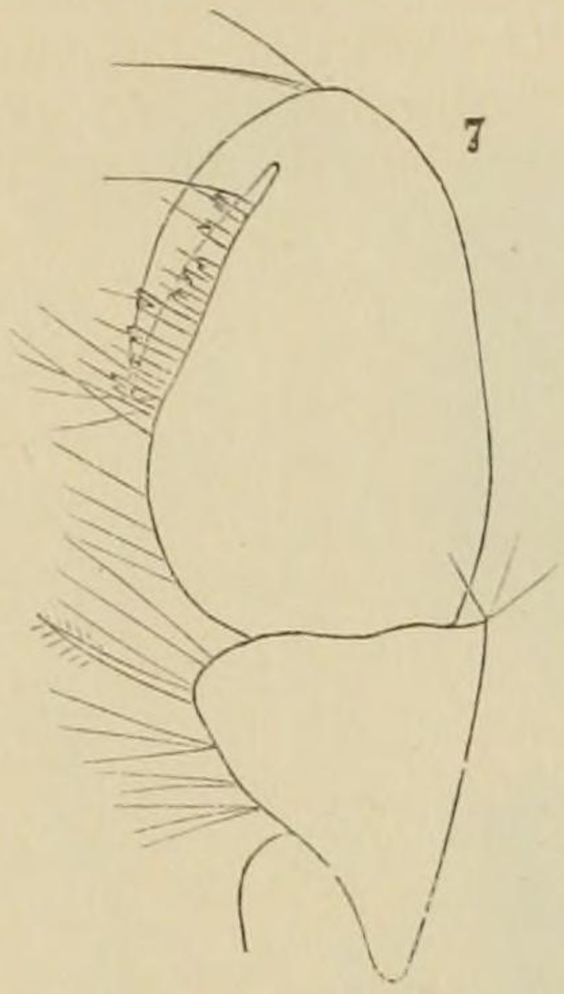
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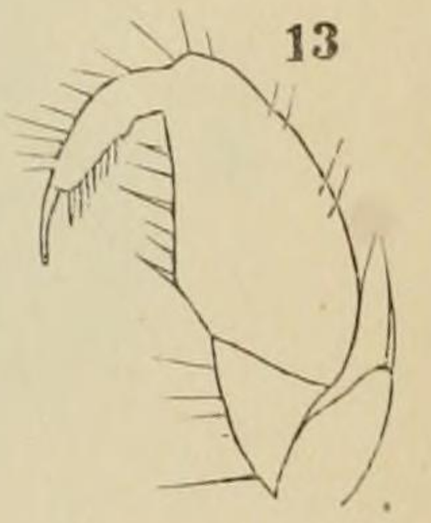
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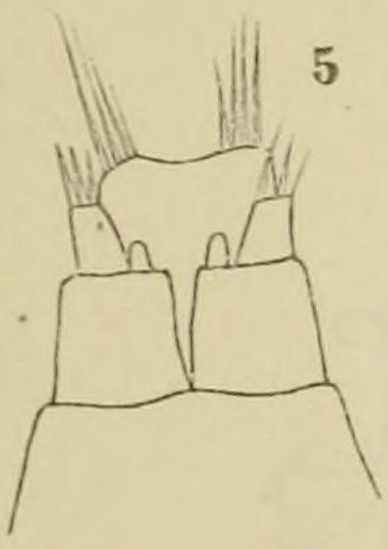
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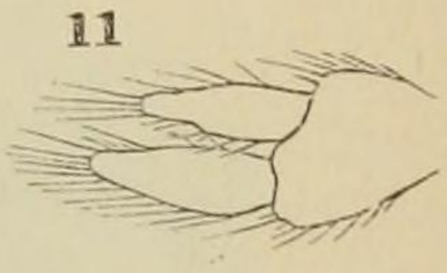
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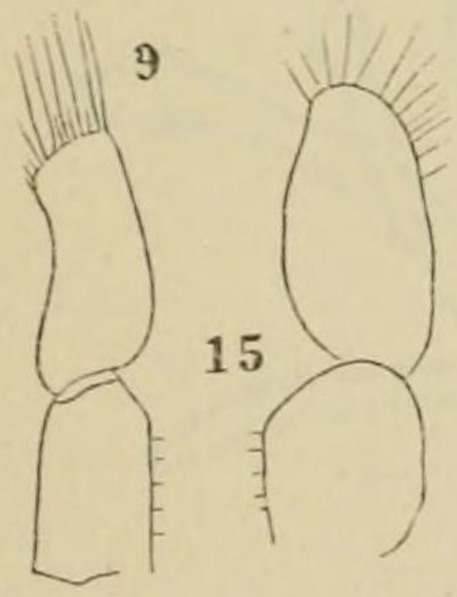
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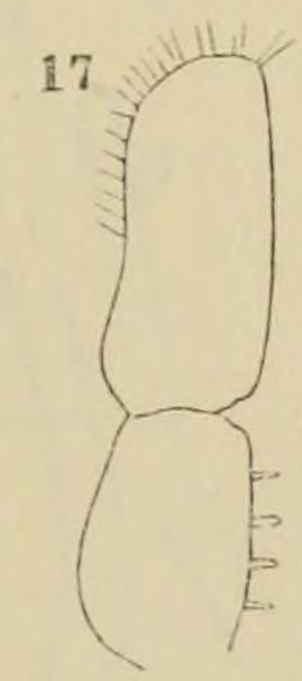
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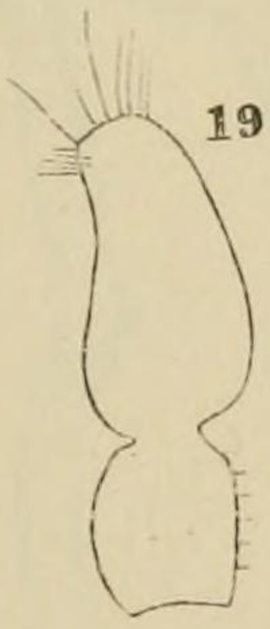
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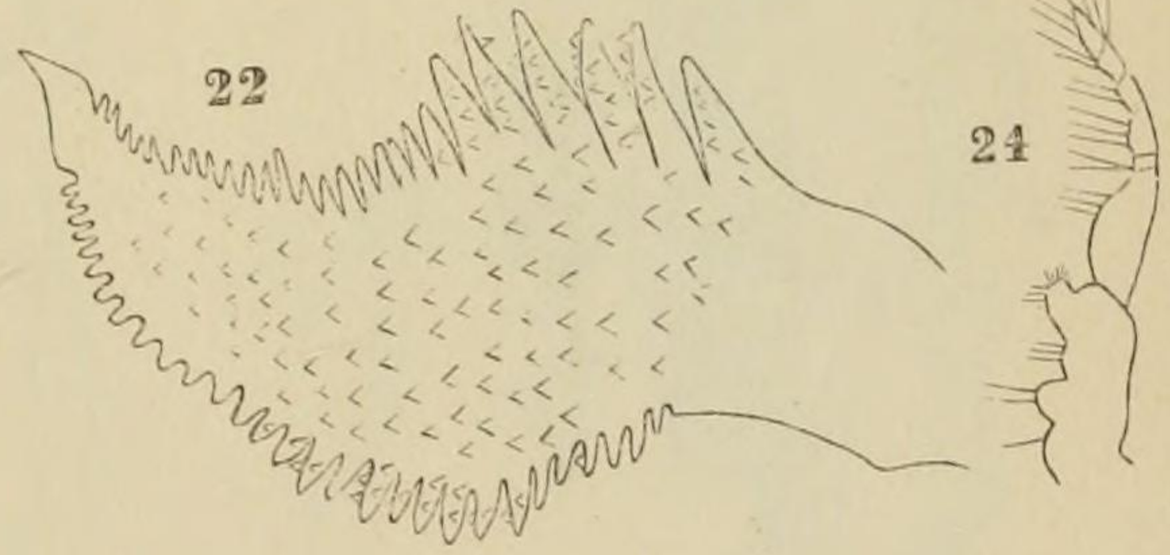
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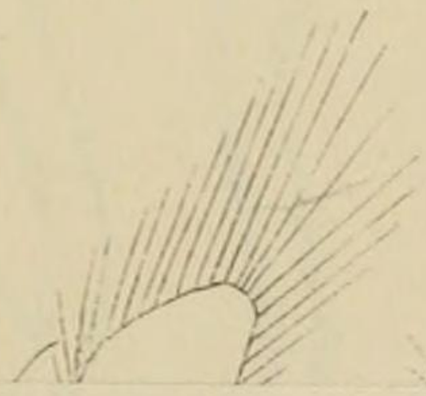
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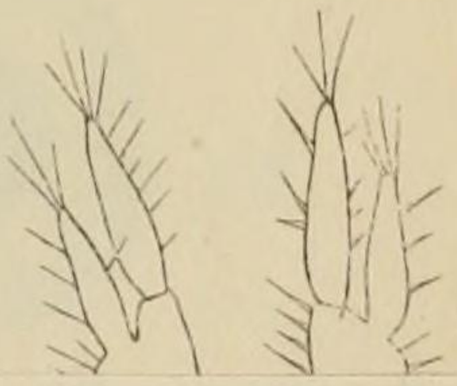
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