

ART. XLII.—*Notes on some apparently undescribed forms of Fresh-water Infusoria. No. 2* ;\* by Dr. ALFRED C. STOKES.  
With Plate III.

THE subjoined fresh-water Infusoria which, so far as I am able to ascertain, have not been previously observed and are consequently undescribed, have, with a single exception, been obtained from the shallow ponds and streams of New Jersey. That they are restricted to that locality, however, is not probable.

*Physomonas vestita*, sp. nov.

Body subglobose, the anterior truncation obsolete; the entire surface clothed with a thin, mucilaginous, finely granular investment, through which penetrate numerous delicate, flexible, ray-like bodies apparently adherent to all points of the surface; endoplasm granular; long flagellum flexible, the distal extremity arcuately curved, twice the diameter of the body in length, the secondary one one-fourth that length, and vibratile; pedicle filiform, flexible, four times the diameter of the body in length; contractile vesicles two, situated close to and slightly in advance of the median line; a linear, slightly curved band or groove near the frontal margin of the body. Diameter of the zooid  $\frac{1}{166}$  inch. Habitat.—Pond-water, with Myriophyllum. Solitary.

In two particulars this species differs from the hitherto single known member of the genus:—in the absence of the truncated anterior border, and in presence of a linear, dark-bordered band or depression near the frontal margin, as exists in *Spumella*. In structure, habits and other essential characteristics it is a *Physomonas*. Influenced, however, by what I at first interpreted to be ray-like pseudopodia, I was not disposed to relegate it to any previously instituted genus, but felt compelled to form for its reception a new generic niche in the order Radio-Flagellata. Subsequent study, however, dispelled that idea and proved the animalcule to be an undescribed species of *Physomonas*. The radiating bodies project from all parts of the cuticular surface, and possess some of the characters of what Dr. Leidy, in his monograph on the fresh-water Rhizopoda, has styled "cils," being, in this instance permanent, non-vibratile, hair-like prolongations which need only to assume a rapid movement to become the familiar cilia. These spicular bodies have no circulation of their substance as do true pseudopodia emitted by the Rhizopoda and some of the lowest of the Infusoria; they are not retractile, neither do they take any part in the capture of food, as in members of the Radio-Flagellata where the nutritive particle,

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dashed down by the short flagellum, is seized by one or more of the pseudopodic projections and drawn into the body. With this form the food, thrown down by the action of the short flagellum, enters at any part of the surface, usually near the base of the flagella, where the part opens, the mucilaginous investment and the adherent spicules moving outwardly on what appears to be a delicate cuticle, a wave-like outflow of the endoplasm surrounds the particle and draws it into the body enclosed in a large drop of water. In length these cuticular spicules are little shorter than the short flagellum.

The nucleus is indistinct and presumably centrally placed, although it was not positively identified. The two contractile vesicles pulsate alternately, and are distinctly apparent. The animalcule is shown in fig. 1, Plate III.

*Bicosœca lepteca*, sp. nov.

Lorica sub-cylindrical, three times as large as broad, truncate and slightly narrowed anteriorly into an inconspicuous neck, somewhat inflated centrally, thence gradually tapering to the acute point of attachment to the pedicle whose length is equal to the greatest width of the lorica; animalcule ovate, with the usual oblique frontal border, the two diverse flagella and the eccentrically attached contractile ligament, the extended body projecting but a short distance beyond the lorica; pulsating vesicles two; nucleus sub-centrally placed. Length of lorica  $\frac{1}{1800}$  to  $\frac{1}{1500}$  inch; width  $\frac{1}{4500}$ ; height of pedicle  $\frac{1}{4500}$ . Habitat.—Pond-water, with Myriophyllum and Algæ.

This minute creature is among the largest, if not the largest of the genus, the loricae of the hitherto known species measuring from the  $\frac{1}{3000}$  to the  $\frac{1}{2500}$  inch in height, the one usually extending to the  $\frac{1}{2500}$  inch is at times found to produce a sheath  $\frac{1}{1500}$  inch high, thus in its most luxuriant growth only equaling the ordinary proportion of *Bicosœca lepteca*, which consequently becomes the most gigantic of those yet recorded. From the only sweet-water species, *B. lacustris* J.-Clk., hitherto observed as a resident in American lakes, it differs so widely that to designate the points of dissimilarity would necessitate an extended description of the form here used in comparison. The loricae, as is so common with those of the Vaginicolina, frequently change from the hyaline condition of youth to a semi-opaque chestnut-brown coloration of maturity and old age; and occasionally a deserted lorica is observed that, judging from this change of tint, is neither young nor mature, for the posterior half has assumed a translucent, chestnut hue while the remaining portion is as colorless as when first secreted. Arguing from this alteration, it is probable that the chemical composition of these sheaths is similar to those of the Vaginicolina,

and the pedicles of some of the Choano-Flagellata, in all of which the change has been observed.

The species is shown in fig. 2.

*Bicosæca leptostoma*, sp. nov.

Lorica elongate-ovate or subfusiform, three times as long as broad, tapering anteriorly to a short neck-like portion, the aperture very narrow, the margins not everted, the posterior half tapering to the pedicle whose length is equal to one-half the greatest width of the lorica; animalcule ovate or subpyriform, occupying the anterior half of the sheath, being entirely enclosed, with the exception of the long, lip-like projection extending beyond the aperture; contractile vesicles two, posteriorly placed; nucleus anteriorly situated. Length of lorica  $\frac{1}{1600}$  inch; height of pedicle  $\frac{1}{800}$ . Pond-water; attached to Myriophyllum and Algæ. Gregarious.

This form most closely resembles that of the salt-water *Bicosæca tenuis* S.-K., and may be considered its fresh-water representative; resembling it also in the proportion borne by the width of the lorica to the length, and in the short distance to which the extended animal protrudes itself, but differing in size, length of pedicle and in the form of the enclosed zooid. The narrow, lip-like prominence being the only portion of the body which extends beyond the lorica, it receives and accepts or rejects all food particles thrown upon it by the flagella. It is usually held arcuately curved, unwelcome particles commonly traversing its concavity to escape, as though urged by a strong current, acceptable matters being engulfed by an advancing wave of sarcodæ. The animalcule is shown in fig. 3.

*Bicosæca longipes*, sp. nov.

Lorica ovate, twice as long as wide, slightly narrowed anteriorly, the margin not everted, tapering towards its junction with the pedicle which is four or five times as long as the lorica; enclosed zooid subspherical, extending but a short distance beyond the aperture; contractile vesicles two, posteriorly situated. Length of lorica  $\frac{1}{3250}$  inch. Habitat.—Pond water; attached to Myriophyllum. Solitary.

With this and the preceding species the long flagellum, when the retracted infusorian withdraws it into the lorica, is spirally coiled as is usual with all the members of the genus, but the great diameter of the coil is here horizontal, so that it appears to rest by its greatest width on the zooid's frontal border. Since my attention was especially called to this feature I have not obtained a specimen of the usually abundant *B. lacustris* J. Clk., but with it, I infer from Saville-Kent's remark, that the longest diameter of the coiled flagellum is vertical, so that the narrow

edge of the spring-like spiral rests on the anterior border of the zooid. Kent's figure exhibits it correctly as it occurs in the present species and the two preceding when about to uncoil itself, the spiral then assuming a vertical position, but he remarks that "the longer of the two flagella, as shown in fig. 17, is thrown into an elegant spiral coil, reminding the observer of the spirally retracted proboscis of a butterfly." This is assuredly not the case in the three species here described.\* The lorica and extended animalcule of *B. longipes* are shown in fig. 4.

*Stylobryon Abbotti*, sp. nov.

Loricæ conical-campanulate, widest anteriorly, not everted, tapering without constriction to the pedicle, twice as long as broad, and united to each other by pedicles about one-half as long as a single lorica, into the cavity of which they are continued, becoming gradually attenuated to their extremity, each lorica usually bearing two loricae which are apparently sessile on the antero-lateral borders of their supporting sheath; primary foot-stalk about six times as long as a single lorica; enclosed animalcule not conspicuously changeable in shape, ovate or subspherical, the projecting lip short; flagella two, the longer scarcely extending beyond the orifice of the lorica, to the posterior portion of which the infusorian is confined by a short, filamentous, contractile ligament; pulsating vesicle single, posteriorly placed; nucleus subcentral. Length of individual loricae  $\frac{1}{1500}$  inch; of primary pedicle  $\frac{1}{250}$  inch. Habitat.—Pond water; attached to filamentous Algæ or other fine vegetable fibres.

This polythecium, unlike that of *Stylobryon petiolatum* (Duj.) S.-K., which it most resembles, is subject to but little variation in its mode of colony-building. As shown in fig. 5, from which most of the zooids have been intentionally omitted, its usual method is to erect a cluster of tapering, bell-shaped loricae by attaching two to the frontal borders of the primary sheath and continuing in this manner until the polythecium is completed. Occasionally, however, the first or supporting lorica bears three, the third being centrally placed, but, so far as observed, not further continuing the tripartite arrangement. The number of loricae composing the polythecium takes a considerable range with age. No colonies have as yet been noted with less than six, neither has it yet been my good fortune to

\* Since writing the above I have seen Prof. Clark's original article in the "Memoirs of the Boston Society of Natural History," i, 1866, where, speaking of *B. gracillipes*, he says: "The only time that the flagellum abandons its rigid deportment is either when it is assisting the lip to seize the food, or during the spasmodic retrocession of the body. In the latter case it is abruptly retracted and coiled transversely within the calyx close down to the truncate front of the body." And of the flagellum of *B. lacustris* he says, "its flexibility is exhibited in the same way as in the other species."

obtain one of these beautiful polythecia exhibiting more than the thirty-one which composed the colony shown in the figure.

The loricae, like those of *Bicosœca lepteca* referred to on a previous page, are remarkable for the great apparent facility with which they change their hyaline condition to a translucent but deep chestnut-brown coloration. As in the *Bicosœca*, again, this is occasionally accomplished so early that in some polythecia, although the terminal loricae have seemed to be incomplete, yet their posterior portions have become brown while the remainder, apparently in process of formation, has been colorless and transparent.

In general appearance this form resembles *Stylobryon petiolatum*, differing, as has been stated, in being less variable in the manner of building up its polythecium, in the shape and posterior position of the enclosed zooids, in the more conical form of the individual loricae, and especially in their much smaller size, those of *S. petiolatum* measuring from  $\frac{1}{800}$  to  $\frac{1}{600}$  inch, while with the present species none greater than  $\frac{1}{1000}$  inch have been observed.

It gives me pleasure to dedicate the species to my friend Dr. Charles C. Abbott, the well-known archæologist and naturalist, near whose farm the beautiful colonies were originally obtained. It seems appropriate that the species should bear his name, since its habitat was the still waters of that attractive region, the vertebrate life of whose upland and meadow Dr. Abbott has described so charmingly in his "*Rambles of a Naturalist about Home*," and on whose fields and hillsides he has discovered so many evidences of paleolithic occupants, and so many specimens of their handiwork.

*Tillina helia*, sp. nov.

Body somewhat bean-shaped, or sub-elliptical with an anteriorly situated ventral concavity; twice as long as broad, slightly widest posteriorly, longitudinally striate and entirely ciliate, the cilia of the posterior extremity longest and most conspicuous, the anterior and posterior borders evenly rounded, the former somewhat curved toward the ventral aspect; oral aperture elongate-ovate, obliquely set within the anterior ventral concavity, followed by short, recurved, ciliated pharynx; contractile vesicle single, situated back of the body-centre in the right-hand lateral border, often leaving after systole a rosette of small vacuoles which finally coalesce; anal aperture opening on the ventral surface near the posterior extremity; nucleus large, ovate, subcentrally situated. Length of body  $\frac{1}{300}$  inch. Habitat. Standing water, with Algæ.

Although the nucleus is correctly referred to as being subcentrally placed, its position in reference to any special region

is not constant. At times it is near and central to the dorsum, at others it is almost exactly in the center of the body, and occasionally it is found near the middle of the ventral surface. The majority of individuals examined had this important organ situated as shown in fig. 21, where it would seem to be in its normal position.

*Derepyxis* (δερη, *neck*, πυξις, *box*), gen. nov.

Animalcule single, inhabiting a pedicellate, flask-shaped lorica to which it is in no way attached; zooid subspherical, enclosing two laterally disposed color-bands; flagella two, subequal, rising from the center of the anterior margin; contractile vesicles two; pharynx presumably represented by a small, colorless space at the base of the flagella.

This is near Stein's *Chrysopyxis*, resembling it in the form of the enclosed zooid, its biflagellate condition and its entire freedom within the protecting sheath; but differing in the constantly pedicellate character of the lorica, the latter, in the genus instituted by the German authority, being sessilely attached to its support. The development of a conspicuous footstalk to the sheath of *Derepyxis* is sufficient to relegate its possessor to a new genus. The infusorian that habitually produces a pedicle before it secretes its lorica, is a little higher in the scale than one that develops a sessile lorica.

*Derepyxis amphora*, sp. nov.

Lorica flask-shaped, transparent, two and one-half to three times as long as wide, narrowed posteriorly and produced anteriorly in a cylindrical neck-like portion one-fifth the entire lorica in length, its circular border truncate, not everted; pedicle short, thick, about one-tenth the length of the lorica; enclosed animalcule occupying the center of the sheath, subspherical, somewhat compressed, the anterior border slightly pointed, this part usually colorless; the endoplasm with two, broad, lateral, greenish-yellow bands; flagella even, diverging, and projecting for a considerable distance beyond the lorica; nucleus not observed; contractile vesicles two, postero-terminal, pulsating alternately. Reproduction by longitudinal fission. Height of lorica  $\frac{1}{800}$  inch; length of enclosed zooid  $\frac{1}{1800}$  to  $\frac{1}{2000}$ . Habitat.—Pond water; attached to algal filaments.

This interesting creature occurs in considerable numbers on the finer filamentous fresh-water Algæ. The lateral color-bands are very broad, often appearing to surround the entire body, a high amplification in such instances being required to demonstrate the narrow chink of colorless endoplasm separating them longitudinally. The tint of these bands is a greenish-yellow deeping to a darker green at the periphery. The infu-

sorian is conspicuously gregarious in habit. It is shown in fig. 6.

*Derepyxis ollula*, sp. nov.

Lorica broadly flask-shaped, one and one-half times as long as broad, centrally subspherical, slightly narrowed at the posterior extremity, the neck-like portion subcylindrical, one-fourth as long as the entire lorica, the circular border not everted; pedicle short, stout, in length about one-eighth the entire height of the lorica; enclosed zooid spherical, the anterior border rounded; lateral color bands as in *D. amphora*; flagella of equal length; contractile vesicles posteriorly located, but not terminal. Height of lorica  $\frac{1}{1125}$  inch; diameter of enclosed zooid  $\frac{1}{2250}$ . Reproduction by longitudinal fission. Habitat.—Pond water; attached to confervoid filaments. Solitary or few together.

This infusorian conspicuously differs from the preceding in the shape and size of the lorica, and in the more spherical contour of the enclosed zooid with its evenly convex frontal border. The tint of the color bands is about that of *D. amphora*; they are similarly broad, and also usually obscure the colorless central sarcode. The lorica and enclosed zooid are shown in fig. 7. It does not so abundantly ornament the supporting algal filament as does *D. amphora*, neither is it so frequently met with in the habitat preferred by both.

*Chilomonas ovata*, sp. nov.

Body evenly ovate, persistent in shape, once and one-half to twice as long as wide, rounded posteriorly, somewhat narrowed anteriorly, the frontal border obscurely bilabiate, the endoplasm enclosing numerous dark-bordered corpuscles; flagella subequal, exceeding the body in length, inserted close together at the anterior apex; contractile vesicles two, pulsating alternately, situated near the frontal margin; nucleus posteriorly placed. Length of body  $\frac{1}{2250}$  to  $\frac{1}{1800}$  inch. Habitat.—The bacterial pellicle on the surface of vegetable infusions.

This form was taken in abundance from the habitat mentioned, in company with a greater number of its comparatively gigantic relative, the *Chilomonas paramecium* Ehr. It is readily distinguishable from the latter by its much smaller size, it indeed being the most minute fresh-water species yet recorded, by its long flagella, and particularly by the presence of two contractile vesicles, and the almost obsolete bilabiation of the frontal apex. The latter is so obscure, the border at times even appearing to be slightly pointed, and the contractile vesicle is so conspicuously double, that I have with some hesitation identified the infusorian as a member of the genus Chilo-

monas, but the other characteristics are so marked that it would seem preferable to slightly modify the generic diagnosis rather than to institute a new genus for its reception.

The dark-bordered corpuscles so numerous within this and *C. paramacium*, are of an amylaceous nature, as is proved by their change to an intensely blue color when the animalcule is killed with iodine. The nucleus is usually so completely hidden by these superposed starchy corpuscles that it is positively located with difficulty. In several individuals, however, these bodies have chiefly collected in the anterior portion of the zooid, in which cases what I have taken to be the nucleus has been left in an almost subterminal position. The mature animalcule is shown in fig. 8.

Reproduction is accomplished by conjugation followed by encystment and quadruple subdivision. Union takes place by the adhesion of the two frontal borders, the body contents of one animalcule slowly passing into and mingling with those of the other, the latter gradually assuming a spherical form and exhibiting four actively moving flagella, as in fig. 9. That the zooids possess a distinct cuticular investment is proved during this process of protoplasmic transfer, for at that time, as shown in fig. 10, the posterior portion of the cuticular coat is left empty, the space slowly increasing in size until after the conjugation has been consummated; the completely vacated cuticular sac adheres to the quadriflagellate spherical result of the genetic union, as shown in fig. 9, whence it gradually melts away. The ultimate fate of the flagella I could not positively determine; my impression is, however, that they are absorbed. They remain visible and active for a considerable time after conjugation; in one instance a single flagellum did not entirely disappear until fission in one plane had been almost completed. The cuticular surface of the united animalcules, swollen into a sphere, becomes the cyst wall within which quadruple division takes place, the four young zooids thus formed differing from the mature infusorian apparently in size only.

In a single instance, previous to the union of the frontal borders, the four flagella became fused into two, after which I suppose the reproductive process proceeded as just described, but as I neglected to supply the water lost by evaporation from beneath the cover glass, the advancing wave swept them from the field and they were lost. Conjugation and encystment have not been observed in the other species of the genus, longitudinal fission prevailing generally.

*Loxophyllum flexilis*, sp. nov.

Body irregularly ovate, lanceolate or sub-triangular, three times as long as broad, transparent, lamellate, very soft and

flexible, widest posteriorly, tapering toward the anterior extremity which is somewhat curved toward the ventral aspect; the posterior margin obliquely and undulately rounded, the ventral border concave, the dorsal one irregularly convex, its posterior region bearing two small, conical elevations; the cuticular surface furrowed lengthwise, often thrown into longitudinal folds, entirely ciliated, the cilia of the anterior extremity somewhat longest and most conspicuous; oral aperture opening subterminally on the ventral surface; contractile vesicles three or more, the largest one postero-terminal, the others small and scattered; nucleus moniliform, the nodules irregularly ovate, centrally situated; trichocysts apparently wanting. Length of body  $\frac{1}{200}$  inch. Habitat.—The bacterial pellicle on the surface of an infusion of dead leaves.

The movements of this infusorian are slow and even, with uncertain changes from one side to the other, and with equally unexpected contortions consisting of indescribably twistings and foldings of the body. The creature's remarkably irregular outline is made more so by the two little projections on the posterior part of the dorso-lateral border. These are constantly present, but vary somewhat in size and form. What utilitarian purpose they may subserve it is difficult to conjecture.

In a single instance I have observed what appeared to be genetic union of two of these animalcules. The combination resulting from this conjugation was almost indescribably irregular, being thrown into numerous folds and plications and rounded projections, the entire creature exhibiting the most deliberate and grotesque writhings and twistings. These separate animalcules were not seen previously to this apparent union, and so long as I was able to follow the apparent combination, no change except of form took place. The normal contour of the infusorian is shown in fig. 11.

*Spirostomum loxodes*, sp. nov.

Body elongate-fusiform, flattened, six to seven times as long as broad, widest centrally, tapering slightly toward both the anterior and posterior extremities, the former rounded and curved toward the left, with a short beak-like projection, the posterior margin truncate; cuticular surface obliquely striate, the cilia of the anterior and posterior borders more conspicuous than those of the general surface; peristome field occupying about one-third of the length of the body; nucleus moniliform, the nodules ovoid; contractile vesicle extending through the entire length of the right-hand border, with a conspicuous posterior dilatation; anal aperture postero-terminal. Length of body  $\frac{1}{85}$  to  $\frac{1}{75}$  inch. Habitat.—Pond water in Western New York.

In external contour this creature bears a striking resemblance to *Loxodes*, and might readily be mistaken for a member of that genus when casually examined with a low power of the microscope. In its own genus it approaches nearest to *Spirostomum teres* C. & L., which is without the acutely pointed sinistral curvature of the anterior margin, and differing also specifically in the presence of a moniliform instead of a single ovoid nucleus, and in the proportion borne by the width of the body to the length.

Reproduction takes place by transverse fission probably following conjugation, as individuals have been repeatedly obtained in the latter condition, the union, as observed, being effected by the mutual adhesion of the peristome fields throughout their entire length. The free-swimming infusorian is represented in fig. 12.

*Vaginicola leptosoma*, sp. nov.

Lorica subcylindrical, three and one-half to four times as long as broad, slightly inflated centrally, thence rapidly tapering to the narrow, truncated base of attachment, the lateral borders of the posterior portion often undulate, the circular anterior margin not everted; animalcule attached to the lorica by a short pedicle, the extended body narrowly elongate-conical, projecting for from one-third to one-half of its entire length beyond the lorica border, the cuticular surface finely striate transversely; nucleus elongate, band-like. Length of lorica  $\frac{1}{16}$  inch. Habitat.—Pond water; attached to Algæ.

The lorica in form resembles that of *Vaginicola attenuata* (From.) S.-K., but is just twice as large, besides differing in the proportion borne by the length to the width. The contracted body of *V. attenuata* is described as urn-shaped; the present species when in that condition is simply obovate. The surface of the former is smooth. The cuticular striations of *V. leptosoma* are distinctly marked. This ornamentation of the surface has not been observed on any of the previously known species. The nucleus is remarkably elongate, extending through nearly the entire length of the body. The lorica and extended animalcule are shown in fig. 13.

*Cothurnia annulata*, sp. nov.

Lorica ovate, two and one-half times as long as broad, the posterior one-fourth widest and somewhat inflated yet tapering to the pedicle and often undulate, the posterior margin conspicuously thickened at the point of attachment to the foot-stalk, the anterior three-fourths, tapering to the circular, truncated margin, which is not everted; pedicle short, slightly narrower

than the extremity of the lorica, where it is apparently widened and continued through the thickened wall as a longitudinally striate prolongation or footstalk to the enclosed zooid; extended animalcule obconical, protruding but a short distance beyond the lorica, the cuticular surface transversely striate and bearing near its middle a narrow, transverse ring-like elevation or ridge. Length of lorica  $\frac{1}{450}$  inch; greatest width  $\frac{1}{1125}$ ; breadth of aperture,  $\frac{1}{1500}$ . Habitat.—Pond water; on Myriophyllum.

The enclosed animalcule here differs from all hitherto known species in the possession of a transversely striated cuticular surface, and the ridge-like elevation encircling the central portion of the body. These points alone are sufficient for diagnosis, although the lorica also differs in form from that of any previously described member of the genus. This with the extended animalcule are shown in fig. 14.

*Litonotus vesiculosus*, sp. nov.

Body elongate, sub-fusiform, produced posteriorly into a tapering, pointed, retractile tail-like prolongation equal to one-fourth the length of the entire body, and extended anteriorly into a narrow, flattened, flexible and extensile neck, about one-half the entire length of the body, its frontal border slightly dilated and widened and bearing trichocysts at the tip; dorsal region rounded, smooth, the ventral flattened, longitudinally furrowed and entirely ciliated; nuclei two, spherical, subcentrally located, and apparently without a funiculus; contractile vesicles numerous, small, scattered throughout the cortical layer of the body and extending in a series through the neck and tail-like prolongations; trichocysts scattered in the cortex of the center of the body; parenchyma of the entire animalcule slightly granular. Length of the extended body  $\frac{1}{40}$  inch. Habitat.—Pond water; among Myriophyllum.

In form this resembles *Litonotus Wrzesniowskii* S.-K., but is undoubtedly distinct. The relative and proportionate length of tail and extensile neck to each other and to the central body, and the form of the caudal prolongation are very conspicuously different from that of the species dedicated to the Russian naturalist; and the trichocysts, instead of being arranged in a regular row at the border of the neck and obliquely directed, are scattered in no apparent order throughout the cortical layer of the central body and at the tip of the neck, but not elsewhere. This portion of the internal structure is of specific value. The chief diagnostic characters, however, in the internal structure, are the presence of very many minute, quickly and irregularly pulsating contractile vesicles scattered about the cortex, while in the animalcule most resem-

bling it the pulsating vacuole is large, single, and located near the origin of the caudal extremity. From *Litonotus pleurosigma*, described by the writer in the American Monthly Microscopical Journal for July, 1884, for which it might perhaps be mistaken if observed only in its contracted state, it differs in greater extensibility of the neck and tail, in the absence of the funiculus between the two nuclei, and especially in the arrangement of the contractile vesicles, those of *L. pleurosigma* being disposed in two rows, one on each side of the body near the ventral surface, while with *L. vesiculosus* they are not only more numerous, but are scattered throughout the body cortex as well as through the tail and neck.

Reproduction is by transverse fission, the dividing plane passing between the nuclei which have previously separated so that, as fission proceeds, each part of the animalcule has a single endoplast. Each nuclear nodule then elongates, quite rapidly divides transversely, the parts separating and becoming subspherical with some rapidity, so that before the completion of the reproductive act, each infusorial moiety possesses two disconnected nuclei, as did the parent. The mature infusorian is shown in fig. 15.

*Litonotus carinatus*, sp. nov.

Body elongate-lanceolate, five to six times as long as broad, extensile to a linear or subcylindrical form with vermicular movements, transparent and flexible, the tail-like prolongation short, obtuse, the neck-like portion in the mature zooid not distinctly distinguishable from the body, the anterior extremity slightly curved toward the right, not dilated; entire dorsal aspect traversed lengthwise by a narrow, convex, keel-like elevation; the ventral surface longitudinally striate, entirely ciliate; oral aperture subterminal; nucleus double, subcentrally placed, the nodules ovate and apparently connected without a funiculus; contractile vesicle single, near the posterior extremity; trichocysts few, confined to the left-hand border of the anterior body-half. Reproduction by transverse fission. Length of body  $\frac{1}{300}$  to  $\frac{1}{250}$  inch. Habitat.—The bacterial pellicle on the surface of an infusion of dead leaves.

The infusorian is represented in its dorsal aspect in fig. 16. It was obtained in great abundance on and beneath the jelly-like layer of bacterial and fungoid growths covering the surface of an infusion of various kinds of leaves, forming for some time the prevailing animalcule. It cannot be easily mistaken for any other species of the genus.

*Litonotus trichocystus*, sp. nov.

Body elongate-lanceolate, flexible and extensile, six to eight times as long as broad, widest centrally, slightly tapering toward the anterior extremity which is somewhat curved toward the right hand and depressed, but not conspicuously distinguishable from the body proper; tail-like prolongation short, posteriorly rounded; ventral surface longitudinally furrowed, entirely ciliate; endoplasm usually coarsely granular; nucleus double, the nodules subspherical, subcentrally placed and connected by a funiculus; contractile vesicle single, near the posterior extremity; trichocysts large, numerous, principally confined to the anterior body-half and the posterior extremity, in the former being arranged in an obliquely directed series along the left-hand border, a cluster at the frontal margin, a few on the right-hand border, many scattered irregularly through the cortex of the center of this region, and an irregular cluster at the extremity of the caudal prolongation. Length of body  $\frac{1}{160}$  to  $\frac{1}{200}$  inch. Reproduction by transverse fission. Habitat.—With the preceding in a vegetable infusion.

Examined in dorsal or ventral optical section this infusorian to a certain extent resembles *Litonotus fasciola* (Ehr.) S.-K. It is, however, easily distinguishable by its shorter and less conspicuously flattened neck-like part, and especially by the number and arrangement of the trichocysts, which are constant and will constitute the chief structural character, aside from contour, by which the animalcule may be readily identified. It is delineated in its extended state in fig. 17. When contracted it becomes broadly lanceolate.

*Chilodon fluviatilis*, sp. nov.

Body irregularly ovate, one and one-half times as long as broad, widest and rounded posteriorly, the left-hand lateral border truncate, the anterior lip-like projection rounded and obscure; ventral surface longitudinally furrowed, entirely ciliate, the cilia of the frontal border the most conspicuous; adoral groove obscure or absent; nucleus large, ovate, subcentrally situated; contractile vesicles numerous, scattered, a single, large, terminal vacuole often developed at the posterior extremity. Length of body  $\frac{1}{500}$  inch. Habitat.—The water of the Delaware River at Trenton, N. J.

This differs from all other forms in its shape, the straight left-hand margin, which is thus far characteristic of it, in the absence of the lip-like prominence and the adoral groove, and in its preference for water not entirely still. The specimens were taken with Algæ from a rapid stream which forms the waste weir of the feeder to the Delaware and Raritan canal, the water

coming originally from the Delaware river, and at the point where the Chilodon was obtained returning to it once more, during its passage forming in the hollows of the rocks and among the little heaps of stones, small comparatively still pools where the oddly shaped creature was oftenest captured. It of course hardly lives and thrives in a foaming brook, nor stems the current of a miniature rapid, yet it seems to prefer a locality where the water is not placid as a mill-pond, although it will take kindly to quiet surroundings. I have preserved it in a vessel on my table for some weeks.

When under prolonged observation it frequently develops a large, postero-terminal vesicle in addition to the pulsating vacuoles constantly present, occupying the entire width of the terminal border and contracting at long intervals. The animalcule is shown in fig. 18.

*Chilodon caudatus*, sp. nov.

Body irregularly obovate, once and one-half to twice as long as broad, widest anteriorly, the frontal border and right-hand lateral margin rounded, the posterior extremity of the flat, entirely ciliated ventral surface tapering to an acute point, the symmetry of the left-hand lateral border interrupted by the sudden narrowing of the body, thus forming a conspicuous, acute, sinistrally projecting lip-like extension; the posterior extremity of the smooth, convex dorsal region produced in a short, conical, acuminate, free but motionless, spur-like prolongation; cilia of the frontal border longest and conspicuous; ciliated adoral groove distinct; oral aperture on the right hand side of the median line in the anterior body-half; contractile vesicles numerous, scattered; nucleus sub-spherical, coarsely granular, posteriorly located; anal aperture on the right-hand border near the posterior extremity. Length of body  $\frac{1}{100}$  inch. Habitat. —Standing water, with *Azolla Caroliniana* Willd.

In other species a common characteristic of the dorsal region is to become suddenly elevated, and so merged into the general surface as to leave a comparatively flat margin or rim surrounding the lateral and posterior and often the frontal borders; but here, while this plane extension of the body exists laterally and at the rear, it is obscure or obsolete anteriorly, and the postero-terminal border of the dorsum is continued as an acuminate and rigid spur. This extension is not a mere narrowed portion adhering to the flattened region beneath, but a free and disconnected yet inflexible projection. That this has any other than an ornamental function I have not observed. It, with the prominent anterior lip, will render the infusorian readily recognizable. The dorsal aspect of the animalcule is shown in fig. 19, and a diagrammatic outline of the posterior portion in longitudinal section in fig. 20.

*DEXIOTRICHA* (δεξιός, *on the right-hand side*, τριχίον, *a little hair*), gen. nov.

Animalcules free-swimming, persistent in shape, entirely ciliate, elongate-ovate or subreniform, rounded posteriorly; oral aperture ventral, followed by a short, entirely ciliated, pharyngeal passage; one or more fine, hair-like setæ projecting from the posterior extremity of the body, and a single series of flexible, setose cilia extending transversely across the anterior right-hand ventral and lateral borders from the margin of the oral aperture to the margin of the dorsal surface; nucleus ovate; contractile vesicle single; anal aperture posteriorly situated.

In several structural points, in one attribute especially, the infusorian for which this new genus is instituted differs from all known animalcules. Its ordinal position is with the Heterotricha, and when a systematic treatise shall be written on our American infusoria, it will probably demand the formation of a new family group for its reception. It approaches nearest to the Bursariadæ of Stein, but diverges widely from the members of that family in the absence of the conspicuous, excavate peristome field, and especially in the presence of the row of adoral cilia on the right-hand side instead of the left, and in the presence of a ciliated pharynx, a feature to be distinguished only under high amplification and the most favorable position of the infusorian and the direction of the illuminating ray. Furthermore, the possession of a posteriorly projecting, filiform seta would alone force it out of that group.

*Dexiotricha plagia*, sp. nov.

Body elongate-ovate, two and one-half to three times as long as broad, the whole surface bearing minute, hemispherical protuberances which give the infusorian, in optical section, a crenulate outline; both extremities rounded, the posterior one widest, the frontal one slightly curved toward the ventral aspect, the anteriorly placed ventral concavity thus formed occupied by the ovate oral aperture; pharynx short, slightly recurved, its cilia projecting beyond the oral aperture; cilia setose; a single series of flexible, somewhat curved, setose cilia extending from the right-hand margin of the oral aperture obliquely backward and transversely across the right-hand side of the body to the border of the dorsal surface; a single, long, filiform seta projecting from the posterior extremity; nucleus ovate, subcentrally placed; contractile vesicle single, spherical, situated near the center of the ventral surface, at the right of the median line; endoplasm enclosing numerous small corpuscles, apparently bi-concave; anal aperture on the ventral surface

near the posterior extremity. Length  $\frac{1}{480}$  to  $\frac{1}{400}$  inch. Habitat.—An infusion of dead leaves. Reproduction by transverse fission.

The object of the unique, one-sided arrangement of the adoral cilia is to direct food particles to the mouth. When the animalcule is quietly feeding, the cilia of the general cuticular surface are all quiescent, with the exception of those on the right-hand side in advance of the adoral, lateral hedge of setose bristles. These alone being in motion, the currents which they produce carry the food particles against the stiffly upheld cilia whose obliquely directed course turns the stream downward and forward to the oral aperture. The pharyngeal cilia project beyond the orifice in a comb-like fascicle only to be distinguished when the animalcule is resting and these appendages are motionless. The infusorian is shown in its right-hand lateral aspect by fig. 22, and the projecting pharyngeal cilia in fig. 23.

Trenton, N. J.

#### EXPLANATION OF FIGURES—PLATE III.

- Fig. 1. *Physomonas vestita*, sp. nov.   × 667.
- Fig. 2. *Bicosæca lepteca*, sp. nov.   × 1200
- Fig. 3. *Bicosæca leptostoma*, sp. nov.   × 1200.
- Fig. 4. *Bicosæca longipes*, sp. nov.   × 1200.
- Fig. 5. *Stylobryon Abbotti*, sp. nov.   × 600.
- Fig. 6. *Derepyxis amphora*, gen. et. sp. nov.   × 900.
- Fig. 7. *Derepyxis ollula*, sp. nov.   × 900.
- Fig. 8. *Chilomonas ovata*, sp. nov.   × 1575.
- Fig. 9. *Ch. ovata* after conjugation with empty cuticular sac adhering.
- Fig. 10. *Ch. ovata* in conjugation.
- Fig. 11. *Loxophyllum flexilis*, sp. nov.   × 260.
- Fig. 12. *Spirostomum loxodes*, sp. nov.   × 187.
- Fig. 13. *Vaginicola leptosoma*, sp. nov.   × 180.
- Fig. 14. *Cothurnia anulata*, sp. nov.   × 677.
- Fig. 15. *Litonotus vesiculosus*, sp. nov.   × 100.
- Fig. 16. *Litonotus carinatus*, sp. nov.   × 360.
- Fig. 17. *Litonotus trichocystus*, sp. nov.   × 350.
- Fig. 18. *Chilodon fluviatilis*, sp. nov.   × 400.
- Fig. 19. *Chilodon caudatus*, sp. nov.   × 720.
- Fig. 20. *Ch. caudatus* in posterior, longitudinal optic section.   Diagram.
- Fig. 21. *Tillina helia*, sp. nov.   × 270.
- Fig. 22. *Dextotricha plagia*, gen. et. sp. nov.   × 530.
- Fig. 23. *D. plagia*, showing ciliation of the pharynx.

